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A MANUAL OF ARBORICULTURE

PRESCRIBED FOR THE USE OF

DISTRICT OFFICERS & COMMITTEES & BOARDS

IN THE

PUNJAB.

LIBRARY OF THE ROYAL ASIATIC SOCIETY

Published under the Authority of the
Punjab Government.

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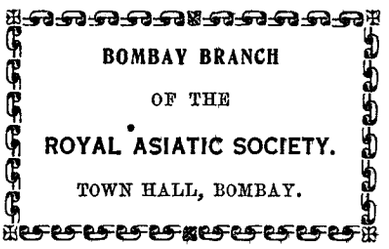
Lahore:
PUNJAB GOVERNMENT PRESS,
1890.



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Manual of Arboriculture

B B P

Bombay branch
of The
Royal Asiatic society
Town Hall bombay

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PART I.

HISTORY OF THE SUBJECT.

MR. B. RIBBENTROP, Conservator of Forests, Punjab, having been desired to bring together in a single paper the various suggestions which had been made from time to time in connection with arboriculture, submitted the report contained in the following thirteen paragraphs.

No. 1990 of the 10th February 1885 to the Financial Commissioner.

2. Under the Sikh and earlier Governments the drift timber brought down from the hill forests by the large rivers of the Province and the naturally wooded *belas* furnished sufficient timber for buildings and manufactures, and the jungles and the bar supplied fuel far in excess of any demand. Even during the Sikh time I am convinced that large areas which should have been, and were once, covered with forests, such as the Pabbi and Jhelum District, had already been denuded ; but though the supply was small, the demand was still less, and neither the Government nor the people had as yet realized the direct drawbacks of deforestation and were hardly sufficiently advanced to understand and appreciate the indirect evils thereof. Soon after the annexation, however, of the Province to the British Empire, a sudden demand arose for large quantities of forest produce : timber and fuel was required for the construction of large public works, barracks had to be built and private dwellings, and the natural drift in the rivers was soon found to be utterly insufficient to satisfy the demand for building wood, and the bar jungles in the vicinity of growing cities and cantonments disappeared rapidly before the large demand for fuel. At the same time cultivation and herds increased, and the naturally slow forest reproduction in our arid Province was still more retarded. The public works were almost at a standstill, and Major Longden was deputed as early as 1851 to explore the, till then, almost unknown hill forests with a view to a more energetic exploitation.

This deputation led to the establishment of timber agencies on the great rivers, and subsequently to the leasing of several hill forests and their management by the Forest Department, when it was found (in many instances it is to be regretted almost too late) that they were rapidly destroyed by contractors, who of course only looked to their own interests and tried to make a fortune in the shortest time possible.

3. The impolicy, however, of being entirely dependent on the hill forests, most of which were situated in foreign territory, for the timber supply of the whole Province was at once understood, and immediately after the annexation

of the Punjab the attention of Government was drawn to the want of trees in the plains, and the Board of Administration, acting with the sanction of the Supreme Government, issued a circular containing the following instructions regarding the steps to be taken by District Officers for encouraging plantations and forest conservancy throughout the Province :—

Board of Administration Circular No. 15 of 1852, prescribing the steps to be taken to encourage plantations and forest conservancy.

1*st.*—Selected tracts of jungle were to be set aside near all great towns and cantonments for the regular supply of fuel, and were to be cut according to fixed rules, the cost of the small establishment necessary for their protection being defrayed by fees to be levied from the cutters.

2*nd.*—Immediate measures were to be taken for ensuring the supervision and guardianship of the hill forests. The boundaries of the villages (including land sufficient for the wants of the communities) were to be defined and the rest of the land declared to be Government property, and the people allowed to collect firewood and fell trees for domestic purposes only.

3*rd.*—The profits of tree planting were to be secured to the growers. At each revision of the settlement the land under copse or planted with young trees not yielding a return was not to be subjected to assessment for the term of that settlement, and even when at a future settlement it was found to be productive, it was still only to be assessed according to the intrinsic qualities of the soil.

4*th.*—New cuts from canals were to be made only on the zamíndárs agreeing to plant both sides of the watercourses with trees at intervals of 14 feet.

5*th.*—At every three miles along the main lines of communication small areas of uncultivated ground, of sufficient extent to employ one pair of bullocks in watering trees, were to be given rent free, so long as they were planted, to those who would undertake to sink a well and plant a grove.

6*th.*—Trees were to be planted (by official agency) round all Government buildings of every description and along roads under construction, and officers in charge of canals were to be instructed to raise plantations at every three miles along their banks ; and at every jail and every tahsíl throughout the country nurseries of young trees were to be kept for distribution.

7*th.*—Officers engaged in forming the new settlement were to require zamíndárs receiving "ináms" from Government to raise one "kanál" (one quarter of a bigah) of young trees for sale or distribution among their tenants.

8*th.*—And, finally, all Government officers were to be called on to encourage planting and to bring to the notice of Government those who distinguished themselves in this way.

4. These instructions were supplemented later on by various others, chiefly from suggestions made by District Officers in the Province.

Thus it was directed that an effort should be made to improve the existing natural forests by sowing them with the seed of hardy and useful trees ; that the alluvial lands newly thrown up from year to year by the action of the rivers should be appropriated for tree plantations whenever the accretion appeared likely to be permanent ; that nurseries of indigenous trees, such as sissu, were to be established near wells

Financial Circular No. 62 of 1855.
Financial Circular No 99 of 1855.
Financial Circular No. 93 of 27th October 1859.
Financial Circular No. 15 of 1864.

so as to furnish a supply of seedlings for planting out in groves near villages and at the corners of fields; and that trees were to be planted at the points of junction of three or more villages.

Many of these orders were allowed to fall into abeyance. When a report was called for, showing what areas of alluvial lands had been taken up for the plantations, it was found that the instructions on the subject had been very generally neglected. Some of the rules were considered impracticable by District Officers, and it was asserted by others that the non-success of the efforts made to increase the growth of timber in the plains was due to the want of a special forest establishment.

Financial Circular No. 13 of 1864.
Letter No. 369, dated 8th September 1864, from Deputy Commissioner of Amritsar, to the Commissioner and Superintendent, Amritsar Division, circulated with Financial Circular No. 62 of 1864.
Correspondence published with Financial Circular No. 20, dated 16th April 1864.

5. In 1861 Dr. Cleghorn, then Conservator of Forests in Madras, was deputed to the Punjab to draw up a scheme for the management of its forests and fuel reserves, and in 1864 a Conservator of Forests was appointed to the Province.

Deputation of Dr. Cleghorn to the Punjab, 1861.

Appointment of Dr. Stewart as Conservator of Forests, 1864.

District Officers were directed to expend the grant allotted for arboriculture in each Local Funds Budget under the Conservator's advice, and, after some consultation, a tabular form showing the results of the works undertaken, and which was to be submitted in duplicate and signed by the Conservator in token of approval, was adopted.

See paragraph 21 of letter No. 417 of 3rd August 1871 from Conservator of Forests to Secretary to Government, Punjab.
Public Works Circular No. 49—3852, dated 25th April 1866.

But Government still sought to encourage planting by private agency. It was directed that a limited area of land was to be given rent free in every village to allow the villages to form plantations of approved trees, and a report was published describing a successful experiment in forming a roadside avenue by digging trenches parallel to the road and sowing them with "kikar" seed.

Financial Circular No. 64 of 1864, promulgating Government of India Resolution in the P. W. Dept., No. 8 of 1864.

Public Works Department Circular No. 18 of 1867.

In 1868 a circular was issued recapitulating all the former orders of Government regarding arboriculture and enjoining all Government officers to endeavour to promote tree planting (1) by planting Government lands through official agency, and (2) by urging the people themselves to form plantations.

Financial Circular No. 6 of 1868.

6. These measures failed, and in 1871 Mr. Baden-Powell, then acting as Conservator of Forests, was directed to suggest further measures for promoting arboriculture without much direct expense to Government.

No. 28, dated 30th June 1871, from Secretary to Government of India, Revenue Department, to Secretary to Government, Punjab;
No. 238, dated 14th April 1871, from Secretary to Government, Punjab; and
No. 2788, dated 3rd May 1871, from Secretary to Financial Commissioner, to Conservator of Forests, Punjab.

Mr. Baden-Powell's scheme for promoting arboriculture in the Punjab, 1871.

Mr. Powell considered that the available agencies by which the gradual planting of districts might be accomplished were—

(1) The people themselves under simple encouragement or compulsion by law.

(2) District Officers and Local Committees.

(3) Canal Officers.

(4) Public Works and Railway Officers.

(5) The Forest Department.

And he endeavoured to estimate what had already been done and what might be done in the future by each of these agencies. But it was found that very little information was to be derived from the returns submitted in accordance with Circular No. 49—3852 of 1866 already alluded to.

Plantations by the people themselves. Mr. Powell's Report, paragraphs 3 to 18.

Although it was reported that in two districts a certain number of plantations had been made voluntarily by the villagers, it was believed that the efforts made to induce the people to undertake such works had generally failed, and there was no information as to what extent, if any, advantage had been taken of the offer of rent-free land along roads and sites for plantations in villages; nor was it known how far Settlement Officers had utilized the opportunities settlements afforded for introducing the conditions regarding planting prescribed in the Board's Circular No. 15 of 1852. Mr. Baden-Powell suggested that more advantage should be taken of these orders at future revisions of settlements; that legislative sanction should be obtained for the measures so introduced; that the rule about planting trees at "Sihaddis" should be absolutely enforced; and that nurseries should be maintained at the public cost for distributing young trees *free* to zamíndárs willing to plant them out.

It was also proposed that Government should be empowered by law to interfere for the protection of private groves and trees growing along fields, either by prohibiting trees being felled altogether or by making replanting compulsory.

Planting by District Officers.

The information given in the District Returns was insufficient to admit of the results of the work done in past years being reviewed. After giving some general information on district arboriculture, planting, selection of nurseries, watering, transplanting, trees suitable for various soils and localities, &c., Mr. Baden-Powell proposed that in future for each district a "district planting scheme," with maps, should be drawn up for five years in advance, and submitted for review and amendment, if necessary, to the Conservator of Forests, who would forward it to Government; and that at the close of the year a brief report or description of the work done should be submitted and compared with the scheme of proposed work. Also that a Manual of District Arboriculture should be prepared for the guidance of District Officers.

A Manual of District Arboriculture proposed.

Canal plantations, paragraphs 93 and 94. Government of India No. 21 F., dated 11th July 1870. No. 763, dated 26th September 1871, from Secretary to Financial Commissioner, to Secretary to Government, Punjab.

Dr. Stewart, Conservator of Forests, had already reported on canal plantations in 1867. Since then they had been removed from the direct control of the Forest Department, and no reports had been received by the Conservator. It was not, therefore, known how far the instructions regarding the planting of the banks of new watercourses contained in the Board of Administration's Circular No. 15 of 1852 had been carried out.

Plantations by Public Works and Railway Officers.

There was little information to record with regard to plantations by Public Works and Railway Officers. Mr. Baden-Powell suggested a previously sanctioned annual scheme for these works, the same as he had already recommended for the operations conducted by District Officers.

Plantations by officers of the Forest Department.

Plantations by the Forest Department to be economical should, Mr. Baden-Powell considered, be concentrated on large areas. The establishment could not undertake small detached works in various parts of the country, nor long lines of roads; such works could only be undertaken by Land Revenue and other Departments.

No. 88½ S. of 23rd August 1871, from Secretary to Financial Commissioner, to Secretary to Government, Punjab.

The Financial Commissioner deemed it impracticable to obtain legislative sanction for the measures adopted by Settlement Officers for encouraging arboriculture, and considered the proposed legal interference with private trees and groves despotic.

But with these exceptions Mr. Baden-Powell's suggestions were accepted by Government, and the preparation of a Manual of Arboriculture was ordered.

No. 35 F., dated 26th February 1872, from Secretary to Government, Punjab, to Officiating Conservator of Forests.

District Officers were directed to submit a scheme for the planting works they proposed to carry out, and afterwards to report on the work done each year in accordance with this scheme; Mr. Ribbentrop, Deputy Conservator of Forests in the Punjab, was deputed to prepare a Manual of Arboriculture, and the control of arboricultural works was transferred from the Public Works to the Civil Department.

Circular No. 14—40 F., dated 26th February 1872.
Circular No. 31—137 F., dated 22nd April 1872.
No. 36, dated 12th April 1872, from Conservator, to Secretary to Punjab Government.
Circular Nos. 31—113 F., 138 F., 139 F., and 140 F., dated 22nd April 1872.
No. 27 F., dated 20th January 1873, from Secretary to Government, Punjab, to Conservator of Forests.
No. 1572, dated 28th January 1873, from Conservator of Forests, to Secretary to Government, Punjab.
No. 77 F., dated 24th February 1873, from Secretary to Government, Punjab, to Conservator of Forests.
Resolution No. 34 F., dated 25th February 1872.

7. Some further correspondence took place regarding the form to be adopted by District Officers in preparing their Annual Report on Arboriculture.

No. 253, dated 31st July 1872, from Conservator, to Secretary to Government, Punjab.
No. 393 F., dated 23rd October 1872, from Secretary, Punjab Government, to Conservator.

It appeared that the suggested forms had not been entirely understood and the schemes for planting operations to be carried on had not been submitted.

Circular Nos. 75, 394 F., 95 F., 396 F., dated 23rd October 1872.

Mr. Baden-Powell in addition to this report on arboriculture has drawn up a memorandum on canal plantations, which had been forwarded to the Chief Engineer, Irrigation Branch, with directions to issue the recommendations contained in it as official instructions to his subordinates. This gave rise to an important correspondence* on the subject of canal plantations, and the Chief Engineer strongly urged the appointment of a special trained establishment for canal arboriculture such as was employed in the North-West Provinces. It was finally directed that Canal Officers were to submit annual arboricultural reports to the Conservator of Forests similar to those prescribed for District Officers.

Circular No. 93486, dated 23rd October 1872.
Memorandum on Canal Plantation by B. H. B. Powell, Esquire, Offg. Conservator of Forests, dated 2nd May 1872; No. 166 F., dated 11th May 1872, from Secretary to Government, Punjab, to Chief Engineer, Irrigation Works.
* No. 7461, dated 21st February 1873, from Chief Engineer, Irrigation Branch, to Secretary to Government, Punjab.
No. 123 F., dated 19th March 1873, from Secretary to Government, Punjab, to Secretary to Irrigation Branch, and No. 124 F., dated 19th March 1873, to Conservator of Forests; No. 252, dated 2nd May 1873, from Secretary to Government, Punjab, to Secretary, Irrigation Branch.

It was not, however, until 1877 that an attempt was made to give (as an appendix to the Forest Report) a general account of District Arboriculture. It then appeared that considerable difference of practice prevailed in preparing the District Reports, and this gave rise to some further correspondence regarding improvements in the form used, and District Officers were directed to submit copies of their remarks, which had hitherto been included in the general "District Fund Report" direct to the Conservator of Forests, who was to frame from them a Provincial Arboricultural Report.

Annual Reports on District Arboriculture.
Circular No. 406 F., dated 15th November 1877.
No. 89, dated 3rd April 1878, from Conservator, to Secretary, Punjab Government.
No. 173 F., dated 5th April 1878, from Secretary to Government, Punjab, to Secretary to Financial Commissioner.

The idea of drawing up five years plans with maps, as suggested by Mr. Baden-Powell in 1872, had not been found to answer well. It was therefore decided that only annual schemes for the expenditure of the arboricultural grant should be submitted.

No. 450, dated 22nd April, from Secretary to Financial Commissioner, to Secretary to Government, Punjab.
No. 213 F., dated 6th May 1878, from Secretary to Government, Punjab, to Secretary, to Financial Commissioner.
No. 214, dated 6th May 1878, from Secretary to Government, Punjab, to Secretary. Irrigation Branch.
No. 214, dated 6th May 1878, from Secretary to Government, Punjab, to Conservator of Forests.
Financial Circular No. 42, dated 4th June 1878.

8. The form for the report on arboriculture was further modified in 1881, and it was prescribed that separate reports on district arboriculture should be submitted each year not later than 15th June by Deputy Commissioners to Commissioners, by whom they were to be forwarded direct to the Conservator of Forests, so as to reach him by the 1st July. These reports were to consist of two parts,—(1) a tabular statement in a prescribed form, and (2) a narrative of the work done under the four headings :—

No. 505 F., dated 9th December 1880, from Secretary to Government, Punjab, to Conservator of Forests.
No. 2210, dated 8th March 1881, from Conservator of Forests, to Secretary to Government, Punjab.
Circular Nos. 119, 120, 121 F., dated 16th March 1881.

General remarks;

Description of work done;

Establishment and supervision; and

Financial results.

This form, with some slight modifications, was sanctioned by His Honor the Lieutenant-Governor.

9. A memorandum giving information regarding various species of Eucalyptus trees was published in 1880, and in 1882 a circular was issued giving the rules of procedure in force for the assessment of planted lands, the grant of such lands, and the form to be used in applying for revenue-free grants of lands for the purpose of making plantations. Circulars No. X of 1865, No. 22 of 1877 and 42 of 1878 were superseded by this circular.

Circular No. 45 of 1880, circulating memo. by Dr. Schlich, Conservator of Forests, on the Eucalyptus.
Rules of procedure for the granting and assessment of planted lands.
Circular No. 34 of 1882.

Circulars cancelled.

10. As already stated, the year 1876-77 was the first for which it was found possible to publish a separate Provincial Arboricultural Report. But as only a few district reports were received, the account of the work done in each was imperfect, and no general statement of the revenue and expenditure was given.

Arboricultural Report, 1876-77.

11. A tabular statement, the first of its kind, drawn up in accordance with Financial Circular No. 42 of 1878, giving a general view of the work done in each tahsíl was added to the Report of 1877-78.

Arboricultural Report, 1877-78.

In his Report for the year 1878-79, the Conservator recommended the appointment for each district or tahsíl of a sufficient number of supervisors of arboriculture, who would become familiar with local methods of planting, and suggested their being sent to the Chánga Mánga Forest Plantation for six months to learn their duties.

Arboricultural Report, 1878-79.

12. The Arboricultural Report for the year 1879-80 was published separately for the first time and separately reviewed by His Honor the Lieutenant-Governor.

Arboricultural Report, 1879-80.

It was hoped that, as the proposal to train overseers and málís at Chánga Mánga Plantation had been sanctioned, an efficient subordinate establishment would gradually be obtained for District and Canal Arboriculture, and that later on when the settlement and demarcation of the reserved forests had been completed, it would be possible to offer the assistance of Forest Officers in many districts.

13. The Report for 1880-81, which was compiled in the new form sanctioned in the Punjab Government letter No. 119 F. of 16th March 1881, was the first to contain a fairly correct financial statement. Two districts, Jullundur and Hoshiárpur, showed a surplus: in the latter the great part of the receipts were due to the sale of wood. This, the Conservator remarked, proved that care bestowed upon arboriculture in the Punjab may, besides securing essential benefits to the people, be accompanied by actual profits.

Arboricultural Report, 1880-81.

The Lieutenant-Governor, in reviewing this Report, was glad to notice improved attention to arboriculture, but found that there was room in some cases for the bestowal of further care on the preparation of the local reports. His Honor would be glad to see still more advantage taken of the course of instruction at Chánga Mánga Plantation, and trusted that it would be soon found practicable to publish a hand-book on arboriculture for the guidance of District Officers, and attention was called to the necessity of not overlooking the requirement of outlying parts of the district for the sake of improving roads and gardens at or near head-quarters.

14. Owing to the late submission of the returns from one Division, at which His Honor the Lieutenant-Governor expressed his strong disapproval, the Arboricultural Report for 1881-82 was delayed for two months. It was considered that the development of the policy of local self-government would add an impetus to the interest taken by the people in the subject of arboriculture and induce wealthy persons to plant groves and avenues as an act of piety or public benefit. It was hoped that the interesting experiments made in connection with the Hoshiárpur *chos* would be continued in future years.

Arboricultural Report, 1881-82.

A list of trees likely to succeed in various parts of the Punjab, with a note on their uses, mode of propagation, peculiarities, &c., called for in the Review of the Report for 1880-81, was given in the Provincial Report for 1882-83.

Arboricultural Report, 1882-83.

The Lieutenant-Governor in reviewing this Report remarked: "If the matter is taken up vigorously much may be done to induce the people themselves, and especially the wealthier landowners, to plant groves of trees. If groves of fruit trees, and trees suitable for fodder, were widely planted over the more arid districts of the Province, round wells and tanks, and natural depressions where water lies, they would add materially to the wealth and welfare of these tracts, especially in seasons of drought. That the people are not altogether indifferent to these advantages is proved by many facts in the present Report; and if nurseries were established at convenient places in every tahsíl and young trees of the kinds bearing fruit or producing fodder were distributed at the expense of the District Fund, the people would probably be glad to take them and raise groves wherever opportunities offer. A distribution of prizes for the best groves, as suggested by Mr. Maconachie, and the grant of small "khillats" and certificates on public occasions to those who exert themselves in the cause of arboriculture, would doubtless have a good effect on individuals; and in the case of villages much may be effected through the influence of the zaildárs and leading men and by petty concessions at the time of settlement."

This subject was still more fully dealt with in the Arboricultural Report for 1883-84, and the printed Review thereon may be read.

Arboricultural Report, 1883-84.

15. On receipt of Mr. Ribbentrop's Report a Committee was assembled at Lahore (on the 26th April 1886 and following days) to consider the subject; and the directions contained in Part II are the outcome of their labours.

PART II.

DIRECTIONS FOR ARBORICULTURE.

A.—ADMINISTRATIVE.

Agencies for tree-growing.

1. The subject of this portion of the manual is the encouragement of tree-growing in the Punjab by agencies other than that of Government in special Departments. These agencies are four, *viz.*—

(1). District Boards.

(2). Municipal Committees.

(3). Village communities.

(4). Private individuals.

Each of these will be discussed separately as far as is practically convenient; but where the remarks or instructions affect more than one agency, they will be found under that head of the subject with which their connection is most important.

(1). District Boards.

Allotments by District Boards.

2. The funds consist of allotments made yearly by each Board for the purpose. An examination of these amounts, as given in the yearly statements, has shown great fluctuations in the same district from year to year; and further, when the amount of each allotment was compared with the income of the Board making it, the proportions in different districts were found very unequal. In the year 1883-84, for instance, while Muzaffargarh spent 8,798 and Dera Gházi Khan 6,907 rupees, the far richer Boards of Ludhiána and Umballa gave only Rs. 4,578 and Rs. 2,090 respectively. Even the greater necessity for effort in the western districts can hardly explain such differences as these. Again, the expenditure of one year in Gurdáspur was Rs. 5,524; in the next it fell to Rs. 2,538, but in the third rose again to Rs. 5,072. Peshâwar, Mooltan and other districts have displayed similar instability. It appears desirable that without insisting on a too rigid uniformity among bodies which are more or less independent, some reasonable approximation to a general standard of allotment should be attained, but the more arid districts of the Province would seem bound to make larger appropriations in proportion to their income than those having larger rainfall, as, besides the greater difficulty they experience in securing good results, the shade and vegetation obtained are in themselves more precious amid the glare of their dry sandy soil; and this appears feasible, because such districts have generally to spend less on the repair of their roads—always a heavy item in the expenditure from District Funds.

Inequalities.

Increase of allotment generally desirable.

Dry districts should make greater efforts.

Allotment not to suffer reduction without sufficient cause.

3. District Officers should use their influence with Boards and Committees to secure that arboriculture allotments do not suffer reduction without sufficient cause, such, for example, as the occurrence of a famine, when it might, of course, be found necessary to curtail under this as well as under other heads.

It will be the duty of the Commissioners to compare, from time to time, the grants for arboriculture made in the several districts of their Divisions, and to take steps to ensure that, due regard being paid to local requirements and to what the several Local Funds can afford, Boards and Committees do not, in this matter, fall short of what may fairly be expected of them.

4. The operations of District Fund Arboriculture fall under the heads of (*a*) nurseries, (*b*) plantations, (*c*) groves, (*d*) avenues. Of these, the terms "nursery," "plantation" and "grove" seem to require some definition. A *nursery* is a piece of land set apart for the rearing and tending of young trees destined to be transplanted elsewhere. When the seedlings are no longer transplanted, but are left to grow up *in situ*, the plot should not be classed as a nursery, but as a grove. A *plantation* is an area planted with the intention of producing a crop of trees, without reference to the individuals composing it. A *grove*, on the other hand, is a group of trees grown for ornament or shade, with special reference to the development of the individual trees.

Four kinds of operations of District Fund Arboriculture.

Definition of "nursery," "plantation," "grove."

(*a*). *Nurseries.*

5. The inadequacy of existing nurseries was apparent. The total area in the Province in 1886 was shown to be 1,633 acres; but of this area 1,209 acres were in the Delhi District and 311 acres in Hazára, leaving a balance of only 113 acres for the remaining districts, of which 18 were returned as having no nurseries at all.

Area of nurseries inadequate.

6. The establishment of district nurseries has two objects, *viz.*, plantation work and the free distribution of plants. Consideration of these objects will indicate the localities where each kind of nursery should be made. The nurseries for planting operations should, of course, be near to the projected work and as numerous as circumstances may require; while distribution nurseries should be located at the head-quarters of tahsíls and other suitable centres where responsible supervision is available. In the case of nurseries of the latter kind, part of the ground should be occupied with fruit trees; and in districts where the demand for flowers and vegetables is small, the subscriptions to the Agri-Horticultural Society, Lahore, might be used to obtain fruit-tree seedlings to be put into such nurseries. Experience generally shows that plantation nurseries are not made in sufficient abundance; and it thus often happens that when planting operations are about to be undertaken, the young trees are not forthcoming in a convenient locality, but either they have to be brought from a distance, or the work has to be postponed. To make timely provision in this way, it is necessary to select sites beforehand, and the District Boards should take intelligent and provident action in the matter.

Two objects of nurseries.

(*b*). *Plantations.*

7. It is probable that, as a general rule, large plantations will not be undertaken by District Boards; but in special cases, where the acquisition of land is easy, or where facilities for irrigation exist, it may be both useful and profitable for District Committees to put considerable areas of land under trees, as has been done in the case of the Kheriwála plot in Ferozepore, and of a similar area in Muzaffargarh. Parcels of land unfit for agriculture can often be had on very cheap terms. Each District Board must consider what it can do with most effect towards the general advancement of tree-growing; and should, where this seems advisable, incorporate such schemes with its general working plan.

Plantations.

(*c*). *Groves.*

8. Groves include *topes* on road-sides and encamping-grounds and groups of trees round serais, schools, dispensaries thánas, district and police bungalows, or rest-houses, &c. The road-side groves, without being of necessity at ten-mile intervals, should be formed at places where travellers usually break their journey. As soon as these stations have been furnished with trees, intermediate points should be taken in hand.

Groves.

(*d*). *Avenues.*

Avenues.

9. It will be found that, in most districts, the planting of avenues has been conducted on the sensible plan of working outwards from the head-quarter station. This arrangement probably affords shade to the maximum number of travellers; it serves to indicate the order in which the work should be undertaken and it should be followed in every tahsíl. Lines of trees should always be planted along the banks of district canals and on bunds.

Protection is all important.

But the effectual protection of the young trees already put out is of greater importance than new work, which should never be allowed to extend beyond the limit within which efficient protection can be guaranteed.

Fencing.

Hints as to the best forms.

10. What substance constitutes the best and most economical fence must depend on local circumstances, and District Officers must exercise their discretion in each case. It may, however, be said that circular walls of masonry without openings for ventilation are both costly and pernicious, and should never be adopted. Bricks radiate heat strongly, and, if used at all, should be built up in the lattice-like structure already employed in some districts. Perhaps in most places a mud wall pierced with air holes, with a trench outside it, may prove the best and cheapest form of protection; but wicker crates are very good, if they can be made up at small expense, which might be done in some districts by the use of "*jhan*" or *pilchi* (*tamarix dioica*) from riverain jungles.

Administrative authority.

11. It is to Commissioners that the chief administrative authority under Government in the supervision and encouragement of arboriculture must be entrusted. Applications for remissions of revenue in connection with Arboriculture should, of course, be submitted to the Financial Commissioner as heretofore, but in other respects the authority next under the Government in this matter is the Commissioner of the Division, who should act with the advice, so far as necessary, of the Conservator of Forests; while, as a matter of convenience, the latter officer should continue to submit the annual or triennial report, because it is only in a central office that the facts reported from the different districts and other departments can be brought into one view. Just as the Commissioner should ask the advice of the Conservator of Forests when required, so the Conservator of Forests will be free to offer suggestions to the Commissioner. But it should be distinctly understood that the Commissioner is meant to be the chief authority in the matter, and in the event of any difference of opinion his views would prevail, unless the Conservator might think it necessary to obtain the orders of Government in the case.

Plans of Operations.

12. Great importance is attached to well-considered Plans of Operations extending over terms of years. Without them there can be no sustained progress. It is not necessary to prescribe any one term for all districts, but periods of from three to five years will generally be found suitable. If financial or other considerations prevent full effect being given in any particular year to the annual programme, the advantages of a matured scheme will nevertheless not be lost for future guidance; for the unfinished work would naturally, in the absence of a sufficient reason to the contrary, be taken up in the succeeding year. In framing these plans the advice of the Forest Officer should, when possible, be enlisted. Where there is a District Forest Officer he will give his aid. When the Commissioner can arrange, in communication with the Conservator of Forests, for the deputation of a Forest Ranger for inspection or for the preparation of a district plan, this course may be freely taken, provided it involves no extra expenditure from Provincial Revenues. And generally Commissioners should understand that the

Government wishes them to see, as opportunities offer, that plans are framed and acted upon; and that they are at liberty freely to apply to the Conservator of Forests for any advice and assistance which he may be able to afford them in the matter. Copies of all Plans of Operations as finally approved should be filed in the Conservator's Office.

Details of working plan.

13. Each plan of arboricultural operations should be drawn up tahsíl by tahsíl, and the proposed work should be described under the main heads of (1) nurseries, (2) plantations, (3) groves, (4) avenues, (5) establishment. An annual lump sum may be provided for ornamental gardens. The Plan of Operations is not meant to be a financial statement, so much as a plan of work, but an estimate of cost is useful as an aid to gauge the practicability of the proposals made. A specimen scheme has been drawn up to exemplify what is here said, and will be found as Appendix A.

Map required.

A map of the district on a scale not less than 8 miles to the inch, and showing boundaries of tahsíls, principal towns, roads, and sites of public buildings, as well as rivers, canals, and any other sources of large water-supply, should accompany each scheme. Any symbols which may be adopted should be convertible so as to show progress and development.

Control Books.

14. The Control Book is intended to be a clear record showing how far the works sanctioned in the Plan of Operations have been carried out, and with what succes. For this purpose a book in the form given in Appendix B. should be kept in the Local Board office of each tahsíl, or, where Local Boards do not exist, in the Tahsíl office. The entries showing results of operations should be made by the inspecting officer, whether Deputy Commissioner or Forest Officer. In the column of remarks will be entered the date of each inspection, the observations made, and any noteworthy facts and suggestions which it may be desired to record.

Establishments.

15. Rigid rules cannot be laid down regarding establishments. The arrangements made in various districts need not be uniform; the main point is to secure what is really necessary and practicable in each particular case. The following remarks may, however, be found useful.

Establishment is of two kinds—
(*a*) Supervising.
(*b*) Executive.

The establishment required is of two kinds,—supervising and executive; but the cost of the former only will ordinarily be charged as "establishment;" the cost of executing works, including the pay of *bhistís*, *málís* or others employed in watering, or protecting individual trees, or lines or groves of trees, will usually be debited to "works." It is of some practical importance that as far as possible the offices of watering and protecting trees should be combined in one and the same person. The supervisor should be active in habit, and possess a sound practical knowledge of planting and pruning. Such a man might be secured by the selection of a young and intelligent candidate passed by the Middle School Standard) who shows some aptitude for the work and sending him to the Central Forest School at Dehra Dún to attend the Vernacular course in order to qualify himself as a "Forester." Such a man would probably turn out good work, if it were occasionally inspected by a Forest Officer or by a qualified Ranger.

Forester.

(2). Municipal Committees.

Scope of operations.

16. The above instructions and remarks apply *mutatis mutandis* to all Municipalities the income of which exceeds Rs. 10,000, though the scope of their work

is smaller than that of most District Boards. Ornamental gardens and public parks will be more prominent features in their arboriculture; but it is important that their attention should be directed to avenues and nurseries, and there is certainly room in most towns for development in this direction. It is true that the minor towns have frequently but a small margin of income available for arboriculture; but each Committee should be required to show greater interest than hitherto in the matter. There may not in all cases be spaces available for tree planting within Municipal limits; but some Municipalities have spent considerable sums on ornamental gardens, and they should, when such work is feasible, be required to appropriate a yearly sum for arboriculture as distinct from such work. What this sum should be cannot be laid down, but it is desirable to increase previous allotments, the amount of the provision which may suitably be made in each case being considered with the rest of the budget. Fruit-tree nurseries should be formed, but the distribution of the plants need not always be made gratis. Where arboricultural operations are found possible, Plans of Operations should be prepared and Control Books should be kept up.

(3). Village Communities.

Conditional works on tanks.

17. When a tank is made or repaired from District Funds, it may be desirable to make a previous stipulation that so many trees shall be planted on or near its sides, or that a plot of land shall be made over to the District Committee for the purpose.

18. It may be found in some places that villagers who do not combine to plant their common land are willing to make a portion of it over to the charge of the District Board.

"Batai" partnerships between village communities and Local Bodies.

In such a case the cost of fencing, sowing and rearing the trees would ordinarily be borne by the District Board, and when the timber is ready for cutting, half the proceeds, or such other share as might have been agreed on, would go to the Board and the rest to the villagers.

Powers under Act XX of 1883.

District Boards, under Act XX of 1883, are bodies corporate, and have, by Section 16 of the Act, power to hold and acquire immoveable property, and to contract and do all things necessary in usual business transactions. If it is expedient for them temporarily or permanently to acquire lands from villages for plantations, they are competent to do so by lease, gift or purchase as may be arranged in any particular case, subject of course to due observance of all standing rules framed under the Act or otherwise.

(4). Individuals.

Rewards for individuals.

19. The action of individuals in planting trees would doubtless be stimulated by the prospect of rewards in money, *pagrís*, *lungís*, certificates, &c., awarded publicly at meetings, such as cattle fairs, canal *jalsas* or district darbárs; but it is not considered necessary to issue instructions limiting or prescribing the action of Local Bodies in this matter.

Appendix C. exhibits a scale of rewards drawn up by Mr. Nicholl for the Amritsar District, which may perhaps be found useful.

PART II B.

Technical.

METHODS BY WHICH TREES ARE PROPAGATED.

Statement of Methods.

Various methods of propagating trees.

1. It is not always possible, or, if possible, it may not be expedient, to propagate trees artificially from seed. Very frequently seed does not germinate freely; or the young plants which spring up may be excessively delicate; or they may be wanting in some desirable qualities possessed by the parent tree. In these and many other similar cases recourse must be had to other modes of propagation.

The methods employed are—

(1). Sowing the seed in the places where it is intended the trees should grow.

(2). Sowing the seed in a garden called a nursery, or in "*pots* or *baskets*," and, when they are old enough to take care of themselves, planting the young trees which spring up from this seed in the places where it is intended they should grow.

(3). Planting "*cuttings*" from trees direct, where the trees should grow, or in a nursery, and, when they have formed roots, transplanting them to the places where it is intended they should grow.

(4). Detaching and planting, in the places where it is intended they should grow, the "*root-suckers*" which spring up round certain kinds of trees.

(5). Obtaining *rooted* branches by the method of *layering*, and planting these where it is intended the trees should grow.

(6). "*Grafting*," "*budding*" or "*inarching*" branches or buds on to the stems or branches of other trees of similar kinds.

(7). And, it may be added, felling certain kinds of trees so that they send out *coppice* shoots having independent roots.

Sowing, Collection and Preservation of Seed.

Collecting seed locally.

2. Whether we sow direct or plant out trees grown in a nursery, seed will be required. The trees it is desirable to reproduce in groves or along roads in the Punjab are to be found, either wild or cultivated, in some part of the Province, and most of them are common in nearly every district. It will, therefore, in most cases be possible to collect the seeds that are required in or near the localities in which they are to be sown, and, whenever possible, it is best to collect seeds in this way, because they can then be had fresh and good. *Seeds should not be collected until they are ripe.* There are generally signs, characteristic for each kind of tree, by which the ripeness of the seed may be recognized; and, as a rule, sound grains are moist, of full weight, and of a healthy colour and appearance when fit to gather. The seasons in which the seeds of each kind of tree recommended for cultivation ripen are given in the calendar. But this should only be taken as a general guide, as local causes may lead to the seed ripening sooner or later than stated. Many trees—oaks, deodár, silver-fir, &c.—shed their seed as soon as it is ripe, and, as it is generally easier to gather the seed while still on the tree, the progress of the ripening of such trees has to be carefully watched. In others, such as sissu, jhand, kikar, &c., the seed remains on the trees for a long time and keeps well, so that there need be no hurry about gathering it. *Healthy mature trees alone furnish good seed:* care should be taken that the seed is collected from full-grown, well-formed, and sound trees. The seed should be collected on dry days, and, *when gathered, should be spread out to dry in the shade.*

Cleaning seed and preparing it for sowing.

3. In many cases it is necessary to remove the fruit or outer appendages of seeds by artificial means. When seeds have to be transported to long distances, they have generally to be "*cleaned*" in this manner. For instance, seeds enclosed in large pods or between scales, as in the case of fir-cones, cannot be transported on account of the expense, and very often cannot be sown until "cleaned." The seeds of the common kikar, jhand, phulai, for instance, unless sown at once when gathered, have to be removed from their coverings. This is generally done very easily when dry, as they then open and the seeds can be picked out with very little trouble. At most they require a little threshing or other manipulation. The same with the cones of the pines and firs. But sometimes, when these are very resinous, as the cones of the chil pine for instance, exposure to the sun is necessary until they open. Some seeds, such as those of the *ber* and all the edible "stone" fruits, are provided with a fleshy covering, which must be removed if it is wished to preserve the seeds. This covering can be rotted off by burying the seed in moist earth or sand. If the fruit is edible, the "stones" can sometimes be purchased from the people who eat them. Seeds which fall from the mouths of animals which chew the cud, or which have passed through the bodies of birds or fruit-eating animals, are often found to germinate more freely than if sown when fresh. Kikar seed, for instance, when gathered from goat-yards, is excellent for sowing.

Preservation of seed.

4. The seeds of some kinds of trees, especially oily or resinous seeds, do not retain their germinating power for long. Such seeds should be sown as soon after being gathered as possible. The seeds of deodár, nearly all the pines, the *oaks, elms, nim, bakain, bamboo, mango, jáman, guava, bael, karaunda,* all the *orange* or *citron* tribe, and some others, are of this nature, and should, therefore, be sown at once when they ripen. And all seeds that ripen at seasons at all suitable for sowing may be advantageously sown at once. This is nearly always the safest plan.

But it often happens that seeds do not ripen just at the time it is suitable to sow them. They must, therefore, be preserved until this season arrives. This preservation improves the germinating power of some seeds, such as *kikar, phulai, oak,* &c. When it is necessary to keep *seeds,* they *should be stored in a dry, well-ventilated place, where they will not suffer from damp, or in pits excavated in dry raised ground, where excess of air and moisture is excluded, and where they can be preserved from the attacks of insects and vermin.* One of the best ways is to pile them loosely, not too thickly, on a pakka floor. This allows the seeds to be turned over now and then, which is very necessary, particularly when first gathered. As a protection against insects, where these are more than usually prevalent, it is often useful to mix the seeds with bitter leaves, such as nim or bakain, or powerful smelling drugs. Rats, mice and smaller vermin may be kept off by storing the seeds in gharras or tin-lined boxes, if in small quantities, or in the drawers in an almirah. Seed can also be well kept and protected from damp suspended from the roof of the godown in sacks, or in large baskets supported on trestles, and by similar devices.

Seed which has been allowed to become damp is difficult to keep sound; it either mildews or ferments. When first stored, this should be seen to and the seed carefully dried in the shade. Seed which is naturally full of moisture or fleshy seeds may be stored in a box or gharra mixed with dry earth or charcoal dust. It is, however, generally preferable to sow such seeds at once.

Soundness of seed.

5. As it is only a waste of labour and money to sow bad seed, whenever there is any doubt as to the *soundness of seed, this should always be tested before sowing.* A rough practical test is to place some of the seed on a nearly red hot iron plate, when all the sound seeds will *burst* before burning. A more reliable test—which, however, takes a longer time—is to sow some of the seed after counting or

weighing in a pot of moist earth and keep it (if in the dark all the better) in a warm place. The number of seeds which germinate will show the quality of the seed.

Quantity of seed required.

6. It is impossible to give any general rules for estimating the quantity of seed that will be required to sow a given area or to produce a given number of plants. Some seeds germinate freely, some the reverse; accidents supervene, and so forth. But the following statement will, when sufficient allowance is made for failures in germination, &c., give a rough idea of the weight of seed, when cleaned, that will be required to produce a given number of plants of some of the commoner kinds of trees:—

Name of tree.	Number of seeds to the seer.	Name of tree.	Number of seeds to the seer.
Kikar	6,240	Peach	100
Khair...	25,344	Amrut	14,968
Wiláyati kikar	10,336	Pear...	42,708
Phulai	28,448	Ritha	658
Siris	7,424	Tamarind	2,376
Ohi	33,248	Bahera	316
Bael	1,048	Harrar	426
Mohwa	410	Kumbar	1,520
Kachnár	9,524	Ber	1,850
Semal	25,248	Putajan	1,606
Chichra	636	Salhe	3,120
Amaltás	6,432	Spruce-fir	6,888
Túu	365,504	Silver-fir	26,752
Khark	4,320	Horse-chestnut	54
Lasúra	16,820	Deodár	7,194
Barna	34,496	Twisted cypress	156,800
Shísham	23,076	Walnut	120
Loquat	910	Blue-pine	15,264
Phálsa	2,450	Apricot	720
Dhamman	2,850	Plum	1,052
Mango	42	Wild pear (kaint)	900
Bakain	1,280	Silver-oak	410
Nim	10,350	Mulin (Calosanthus Indica)	10,496
Champa	5,800	Dillenia Indica	46,144
Khirni	5,456	Wood-apple (kait)	22,000
Sohánjna	5,600	Asoka	88
Kemal	5,398	Maple	7,232
Amla	42,528	Pajja	4,330
Chil	6,976	Elm	39,092
Sukhchein	468	Bamboo (B. arundinacea)	28,160

Direct Sowings.

Cases in which direct sowings are advisable.

7. There are comparatively few instances in which sowing the seed direct, in the places where it is wished the trees to grow to maturity, is the safest or most economical method of propagation.

By making use of a nursery, the seed can be sown in a highly prepared soil, and the young plants carefully protected against all harm. Sown *direct*, the seed is liable to be eaten by insects or birds, the young plants that come up have to withstand the effects of sun and drought or frost, and are liable to be choked by the grasses that spring up with them. But groves or topes of hardy indigenous trees, such as *phulai, ber, kikar, sissu, horse-chesnut, oaks*, the *chil* pine, &c., &c., may sometimes be produced in suitable situations by direct sowing. In most cases it will, however, be more economical to *plant* trees; for where direct sowings are made, there will always be failures from all sorts of causes—bad seed, bad sowing, attacks of insects or birds or mice, or deaths from frost or drought or sun. These accidents will cause blanks, which will have to be resown year after year, and this will probably in the end make the operation more expensive than planting. Besides, the crop will be *patchy*, trees of all ages being mixed together.

Preparation of the ground for broadcast sowing.

Where it appears advantageous to produce a grove or young forest by means of direct sowings, the ground to be sown must first be cleared and worked up. In most cases, after the preliminary clearing, all the necessary cultivation can be done by ploughing, and, where this is possible, it will be the cheapest

way. The ground ought to be turned over, if possible, at least six months before sowings are commenced and ploughed or dug up several times in the interval. The best season for giving the first cultivation is after the rains, while the ground is still moist. The land so prepared may then be sown broadcast. But better results will be obtained, as a rule, by sowing along prepared lines, or trenches 5 to 10 feet apart. This is especially the case where a large area has to be sown and the land is irrigated.

Partial sowing in prepared places.

Where the cultivation of the whole area is too expensive, good results can generally be obtained by a *partial clearing* and cultivation of the ground. This may be done along the ridges or sides of irrigation trenches, or along furrows or strips cleared at regular intervals over the land; or plots, holes, pits, or mounds may be prepared at regular or irregular intervals throughout the land.

On irrigated ground *sowing along trenches* will be found to be better than flooding the whole area and sowing broadcast. The trenches should be parallel, at from 5 to 10 feet apart, and 1 foot deep. The seed should be sown on the earth thrown up from the trenches. When the rainfall is small, but fairly sufficient, *trenches to catch the rainfall* will be found to answer well on sloping ground, but the seed should be sown both in the trenches and on the ridges.

Prepared strips, cleared and cultivated, may be sown in the same way. This is the best way of sowing wherever irrigation is not required, such as land liable to be flooded, or *sailába* land near a river, and open spaces where the rainfall is abundant. Mounds are sometimes used in very wet places, such as hollows where water lies, and so forth. Seed may be sown, or trees or cuttings may be planted, on such mounds with equal success. Where the trees are protected from injury after they come up, direct sowings are more often successful in such situations than elsewhere.

Plots or other prepared places are treated in exactly the same way as the strips. It is necessary sometimes to sow in this manner where parallel trenches or strips cannot be made, as, for instance, where there are numerous stumps of old trees or rocks and boulders on the ground; or in *sailába* land, where there are dense tufts of kána grass which it costs too much to dig out. The only objection to these plots is that supervision is more difficult than in the case of parallel lines.

Sowings in Nurseries.

Cases in which it is necessary to grow trees from seedlings raised in a nursery.

8. When it is desired to establish trees by *planting* instead of sowing them in the places where it is intended they should grow, it is necessary, unless self-sown seedlings are collected (which is not often possible), to sow the seed in a garden or "*nursery*," where the young plants may be carefully watered and attended to until old enough to be planted out. When isolated trees have to be grown along roads or streets, or when groves have to be formed on ground covered with jungle, this is the only safe method of propagating them.

Soil.

9. The ground selected for a nursery should, if possible, be of good soil, such as would be chosen for any other garden. Soils on which the common crops of the country grow well will generally be suitable. In the drier districts the thorny vegetation on unirrigated land gives the soil an appearance of poverty; but very generally such soils, if irrigated, will be found to be fairly fertile. The soil should be an admixture of clay and sand with gravel, and the finer portions when moistened and pressed between the fingers should not feel very gritty. Sandy soils do very well, but stiff clayey soils, though fertile, are not good for tree-growing, and are especially bad for a nursery. Such soils generally show deep cracks in the surface during hot, dry weather. These soils are difficult to work up by digging, and the young roots of growing plants cannot easily penetrate into them. The nature of the *subsoil*, provided it is permeable, is not of much importance. But an impermeable subsoil—a kunkar bed, for instance—is bad.

Laying out nursery.

10. The site being settled, it will be necessary to clear, fence, manure, work up and lay out the ground for sowing, and, where irrigation is necessary, to make the requisite water-channels. In all cases a nursery should be regular in shape; rectangular if possible. This facilitates laying out the beds and trenches, calculating areas to be sown, and so forth.

In preparing the ground, all stumps and *roots of trees* and large stones should be removed, the surface made fairly level, and the whole ground well cultivated, so as to give the seedlings a thoroughly permeable soil to develop their roots in. This cultivation should be commenced after the rains and

repeated several times before the sowing season. Moderately deep cultivation, about 2 feet, is sufficient. For transplanting it is better that the roots should develop near the surface.

Manuring the soil.

11. In preparing the soil of a nursery for the first time, it will generally be necessary to improve it by adding manures, mould, or prepared soil, according to its requirements. Stiff clayey soils will be improved by the addition of sand or silt from a canal, or of charcoal or brick-dust. Sandy soils will be improved by the addition of fine clay or silt from the bottom of a tank or stagnant pool. Lime may be added to peaty ground, or recently broken up grass land; both stiff clays and loose sands are improved by it. The best general addition to the nursery soil is, however, *vegetable mould;* that is, leaves and weeds which have been well decayed. Such mould should be prepared in every nursery, in pits two or three feet deep, situated in a shady place. One of these pits should be filled from time to time by leaves, weeds, &c. These should be kept damp by occasional *slight* waterings, and so allowed to decay slowly until ready for being mixed with the soil of the seed beds.

After the nursery has been some time in use and crops of seedlings have been removed, the soil will become exhausted unless manured by some *strong* manure. The most easily procured is farm-yard manure, obtained by rotting the droppings of domestic animals in pits similar to those used for preparing mould. The droppings should never be used fresh. From 300 to 400 maunds of such manure should be given per acre. For old fruit trees more powerful manures, such as bone-dust, poudrette, &c., will be found useful.

Laying out the nursery beds.

12. The ground must then be formed into beds for sowing. The paths or trenches between the beds should be from 9 inches to 1 foot deep. The beds ought not to be more than 3 feet broad, so that the coolies can reach half-way across them from either side when weeding. But it will frequently be better to sow on parallel ridges than in beds. Seedlings will grow with greater rapidity on such ridges than in beds, and will be more easily transplanted. The roads and paths should be laid out so as to meet local requirements, and should divide the nursery into more or less equal rectangular divisions.

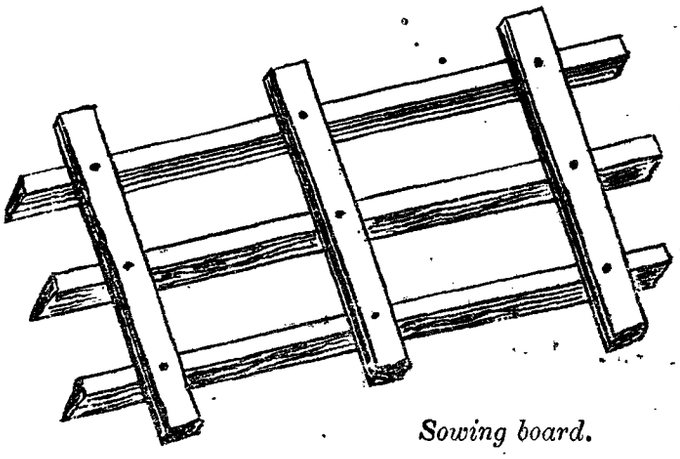
In the hills, or in hilly or very broken ground, *small* nurseries will have to be made wherever sufficiently level places can be found. In such ground the *beds* should be made nearly level, as otherwise the soil and seed will be washed away. Any water coming from the ground above should be diverted.

Before being sown the soil of the beds should be worked up very finely with the hand, *raked* level and smooth, and then slightly *pressed down*, so that the seeds may not be exposed by the washing away of the soil. The ground should be moderately moist, but not sufficiently wet to stick readily to the fingers when being handled. Some seeds will not succeed unless sown in very carefully-prepared beds in which the soil has been mixed with charcoal or brickdust, &c. Some require such special protection against vermin that they have to be sown in cases covered with wire-gauze, &c. But as the cultivation of such delicate seeds without the aid of a skilful horticulturalist is not recommended, it is unnecessary to describe these special methods here.

Sowing the seed.

13. Many seeds have a hard outer covering, and do not readily absorb the moisture necessary to enable them to develop and burst their shells. Such seeds before being sown should be soaked in water and frequently stirred for a considerable time, or they may be put in heaps and moistened or buried in moist manure or damp sand, where they get both warmth and moisture until they are about to germinate. When sown in prepared beds, the seed may be either sown broadcast or in parallel drills or furrows a few inches apart. Drills or furrows, as a rule, are best, as they require less seed, and the seedlings are more easily kept free from weeds and readily removed when they come to be transplanted. The sowing should be carefully done. *The seed should not be*

thrown down in one place by handfuls, but evenly and thinly strewn by hand, or by other means, in the same way that ordinary food grains are sown. After being sown the seed should be covered with earth, so as to prevent its being blown or washed away, devoured by birds, or injured in any way. *But it should not, as a rule, be covered with more earth than about twice the thickness of the seed itself.* For making the furrows, the best way is to have strips of wood of the required size nailed on to cross-pieces in parallel lines at the distance apart it is desired to make the drills, and to press these into the beds. Large seeds are usually put in one by one by hand, but small seeds can more easily be *poured* into the furrows from a bottle or horn. Very small light seeds should be previously mixed with finely-sifted dry sand. Fine mould or manure should also be placed along the bottoms of the furrows. When the seed has been sown, earth, or, better still, finely-sifted vegetable mould or manure, should be filled in over the seed to the proper depth.



Sowing board.

14. As a general rule, the early spring, just before the leaves appear, is the best season for sowing in the plains where the ground must be irrigated. Where the rainfall is more abundant, as in the lower hills, the commencement of the rainy season is the best time to sow. But some kinds of seeds, as already noted, must be sown at once whenever they ripen; and in the higher hills, where snow lies throughout the greater part of the winter, the best time to sow is the autumn, as the seed will be preserved under the protection of the snow until the spring.

Season for sowing.

15. In the dryer plains it will be necessary to keep the seed-beds evenly and moderately damp, not soaked one day and dry the next, from the time of sowing until the commencement of the ensuing cold weather. The freshly-sown seeds and the young plants as they come up are sought after by a horde of enemies. Birds and monkeys can best be kept away by watchers, but it is also useful to spread thorny branches over the seed-beds. Rats, mice and moles may be trapped; the former can be poisoned by grains of wheat prepared with strychnine. Hares, and especially porcupines, are more difficult to deal with. Various chemical preparations have been devised for keeping off insects. Wood-ashes sprinkled over the beds have sometimes a good effect. Grubs which gnaw the roots have to be picked out one by one. White-ants are often very destructive, but the drenching of the soil by irrigation keeps them away. The best possible precaution with hardy kinds of trees is, however, to sow good fresh seed very thickly at the proper season, when it will germinate quickly, and in well-prepared beds, where the young plants will be vigorous and grow fast. As a rule, a sufficient number of seedlings will then survive all injuries.

Treatment of seed-beds after sowing. Noxious animals and vermin.

16. It will generally be necessary to shade the beds from the midday sun. Moveable screens made of *kána* or other easily procurable grass are the best, but a light covering of branches along the lines of seedlings will sometimes serve the purpose. Very frequently seeds are believed not to have germinated when in reality they have done so, but the young plants have been burnt up by the sun as fast as they appeared. During the cold weather, when frost prevails, young plants should also be covered at night by mats or *tatties*. Frost, next to insufficient rainfall, is the greatest enemy to tree-growing met with in the Punjab.

Shading the seed-beds from frost and from sun.

Shady branches stuck between the lines of seedlings are also a cheap and useful protection against frost. The ground between the lines of seedlings may also be covered with straw during the winter months to keep the roots warm.

Weeding beds.

17. It will be necessary to weed the seed-beds two, three, or more times during the year. This is particularly the case in irrigated grounds during the hot weather, when the growth of jungle is extremely fast. The chief weeding season is from April to September.

Management of the seed-beds.

18. The beds after being sown should occasionally be worked up and not be allowed to "cake," as some seedlings, when germinating, cannot easily force their way through the soil. This loosening of the soil is best done with a fork or small pick. The leaves of young seedlings, when the surface of the soil becomes hardened, sometimes assume a pale, sickly colour, the bark *contracts*, and they become "*hidebound*." If when in this state the soil is carefully hoed and worked up between them, and the beds are irrigated, new shoots are frequently formed and the seedlings recover. When the seedlings are too thick, they must be thinned out as they grow, so as to leave room for development. The more weakly plants should be removed, and the more robust favoured. But a uniformly equal distance between the plants is not necessary. All young plants with good stems, clear bark and fine leading shoots should be left, and any weakly plants interfering with their growth should be removed.

Sickly plants, which have suffered from frost or cattle, &c., may be improved by cutting the stems clean off at the level of the ground, and thus causing coppice-shoots to take the place of the old stems, the ground being hoed and irrigated at the same time.

Transplanting to be avoided if possible.

19. By thinning out seedlings sown on ridges as they grow larger, until the seedlings stand at from six inches to one foot from each other according to size, *transplanting in the nursery may be often avoided*. This is a most important point in this country, where, owing to the carelessness of the labourers and the difficulty of obtaining good supervisors, the roots of the seedlings are apt to be injured during transplantation. This plan of weeding down, instead of transplanting in the nursery, is recommended wherever very large seedlings are not required, as, for instance, where the seedlings are to be planted out closely in lines in a fenced enclosure to form a grove.

Curtailment of tap-root of seedlings left in the nursery.

20. Where the seedlings are left for any considerable time in the seed-beds, it will be necessary to cut off the long "tap-root" in the case of most kinds of trees which send a long root down into the soil; otherwise the lifting of the seedlings would be difficult, and would cause damage to their roots. This shortening of the tap-root causes the seedlings to form a bushy mass of fine rootlets near the surface, which can be removed without injury. The tap-roots can easily be cut off with a sharp spade, or, if the seedlings are growing in lines, the soil can be removed along one side of the lines and the tap-root of each seedling cut off with a knife. The tap-roots of pines and firs should not be cut off. These kinds of trees should be planted out while small, or, if large-sized seedlings are required, they should be transplanted in the nursery while very young, and afterward as often as may be necessary.

Transplanting when necessary.

21. Where large-sized plants are required for planting out along road-sides, &c., it is necessary to transplant the seedlings from the seed-beds to other beds in which they will be at a greater distance apart, and so be able to develop large *manageable* roots and grow to the size that is required. The plants should be "*lifted*" from the seed-beds as soon as they are of a convenient size to handle. The roots if injured in transplanting should be pruned with a sharp knife. The older the seedling the more care the operation of lifting and transplanting

requires. *Quite young seedlings*, if the soil is light and moist, may even be pulled up by the hand without being injured. But older plants cannot be treated in this way, and it will often be necessary to transplant them with all the earth that adheres to their roots.

A cheap and expeditious way of lifting plants from the seed beds, when the seedlings have been sown in drills, is to dig a trench at a short distance and parallel to each line of seedlings. The plants can then be pushed into the trenches helped by the spade from behind.

For road-side planting standing trees are required, *i.e.*, trees having a clean stem of seven or eight feet without branches. During the growth of plants required for this purpose the side shoots should be removed, none being left until the tree has attained the desired height.

Planting out in the nursery lines.

22. The seedlings may be replanted in trenches dug in the transplanting beds, or, if they are large, in pits, the roots in all cases being gently placed in their natural position, and not, as coolies will do if not closely watched, doubled up into whatever shape may be most convenient to make them "*sit*" straight while the earth is being thrown in on them. Before being planted in the nursery lines, all broken roots, &c., should be cut off above the point of injury with a *clean cut* of a sharp knife. Long roots that require curtailing may also be removed in the same way, and dead or dying twigs cut off. Good soil or leaf-mould, or light manure, should be strewn over the bottoms of the trenches or pits in which the young plants are put and brought in contact with the roots. The seedlings should be replanted as soon as possible after being removed; otherwise the finer roots, which are of the utmost importance in the life of the plant, are liable to dry up. Where immediate planting is not possible, the roots should be protected by damp grass, or light soil thrown over them as they lie. Dipping the roots in mud, as is often done, is not advisable, as the finer roots become entangled. When taken out of the beds, the seedlings should not be thrown in heaps anyhow, but should be neatly laid, roots down, against the side of a trench until removed. The work of digging out, removing to the transplanting beds, and placing on the ground should be done in an orderly and systematic manner, and more seedlings than can be replanted within a reasonable time should not be dug out.

Several transplantations sometimes necessary for large seedlings.

23. It will generally be necessary, when seedlings have to be kept in the nursery for a number of years, as happens sometimes, especially in the colder climates of the hills, where growth is slow, to transplant the seedlings several times over in the nursery lines. In no other way can fibrous, compact roots of the form most convenient for transplanting be obtained.

Season for transplanting.

24. In the plains, or in the hills as a general rule, the cold weather well before the young leaves begin to come out is the best season for transplanting deciduous trees, and the first six weeks of the monsoon for evergreen ones. In dry districts, where irrigation is impossible, all transplanting should, however, be done during the rainy weather.

Irrigation and protection.

25. The trees transplanted should be watered immediately they are put into the ground, and in the plains this should be repeated at frequent intervals during the whole of the hot weather, and until October in the south of the Punjab.

If the nursery is fenced in, the young plants will require but little other protection. The transplants will require to be weeded and tended, and the ground should be hoed up occasionally. The plants will sometimes require to be *pruned* into a good form, and during the winter protection from frost will often be necessary.

Raising Seedlings in Pots and Baskets.

26. Seedlings may often be advantageously raised from seed sown in flower pots or boxes, the weaker seedlings being gradually removed until only one remains. Or young seedlings from the nursery beds when quite small may be pricked out into the pots and sent off to the place where they are required, or where they can be looked after until old enough to be planted out.

This method of raising plants in pots is a favourite one with gardeners. It is a very good way of raising delicate seedlings or those of which the seed germinates with difficulty, or is much preyed on by birds or vermin.

It can also be used for planting out small areas, and where, in order to secure the supervision of the local officials, it is wished to grow seedlings near a kacheri or public building where no place for a nursery exists, this method is useful. Under the orders of Government the system has been largely tried in the Bombay Presidency.

"For planting, the seedlings are kept in the pots, usually for rather less than one year, then carted out to their site and planted. This method is good enough where the area to be planted out is small, and water can be made available for the plants after potting, as alongside a tank or canal. In the pot-culture of trees the following method should be followed as nearly as possible:—

"As soon as the seedlings are large enough to handle easily, they should be put singly into pots 4 inches in diameter at the top, and, as soon as the roots have reached the sides of the pot, the plant should be shifted into a bigger one 6 to 8 inches in diameter. By the time the root have nearly filled the pot, the plant will frequently be large enough to plant out. If this cannot be done, it may be shifted into a still larger pot, the object being to prevent the roots becoming so matted together that they cannot be readily separated. A plant in this condition is said to be "pot bound." Watering plants in pots is almost invariably performed by natives in an imperfect manner; a small quantity is given frequently, but seldom enough to wet the whole of the earth in the pot. Water should be given as often as the earth gets dry and before the plant begins to droop, and at each application sufficient should be given to go through and run out of the bottom of the pot.

"Where irrigation is available, or water is easily obtainable, plants from pots can be put out at almost any season of the year. If done in the dry weather more care is required at first than if done during the rains.

"With careful handling, if the pots are reasonably good, they may be used over and over again; but before using a second time they should invariably be thoroughly washed inside and out.

"In moving or shifting a plant from one pot to another or to the open ground, the plant is taken in one hand near the earth, turned upside down, and the rim of the pot gently tapped on a post or piece of wood until it separates from the earth, when it may be lifted off with the other hand.

"If dirty pots are used, such separation is not readily effected.

"A well drained pot is in every case essential, and this is effected by placing a piece of broken pot over the hole in the bottom and a few small pieces above. These should again be covered with moss or leaves to prevent the soil mixing with the drainage material.

"When transferred to the open ground, the pot should be entirely removed and a few of the principal roots opened and spread out in a radiating manner all round the tree, covering in with soil in the usual way, pressing it down and watering. It will generally be necessary to water the plants a few hours before taking them out of their pots, as if the ball of earth is quite dry when put into the ground, water will not readily be absorbed on account of the soil which was in the pot being harder than the newly moved earth in which it is placed:"

Potting soil.

27. It is very important that the soil used for growing plants in pots should be good, as the plants have so little soil to grow in. Vegetable mould made from leaves, &c., mixed with an equal quantity of stable-manure which has been allowed to decay for one or two years makes an excellent potting soil. Where ordinary soil is used, it should be taken only *from the surface,* where the air has been able to act on it.

Reproduction by Cuttings.

28. The branches of most broad-leaved trees, when cut off and placed in moist soil during warm weather, will throw out roots, and, in the light, leaves. The banyan and other figs, willow, farásh, simal, and a great many other well-known trees, possess this power in an extraordinary degree. Such branches when used to reproduce trees are called "cuttings."

Meaning of term "cutting."

29. This method of reproducing trees is well understood and popular among the people of the country, and is very often the easiest and cheapest method of propagating certain kinds of trees. But such trees are apt to be unsound at heart, and are shorter lived than trees raised from seed. Cuttings may either be put out direct in the places where it is wished to grow the trees, or they may be set in a nursery until they have struck root and then planted out in the same way as seedlings.

Cases in which it is advantageous to reproduce trees by cuttings.

30. *Large cuttings* of such trees as can be reproduced by this method may sometimes be advantageously planted direct along road-sides, &c., when the ground can be well irrigated (in the plains), or when the rainfall is sufficient and the soil good. From their height and stoutness they are little liable to injury from men or animals, and, when they can be used, they do away with the necessity of making and maintaining expensive nurseries. Such cuttings should be from 5 to 10 feet long, and should be set 2 feet to 3 feet in the ground, in holes or pits prepared for them, of which the soil at the bottom has been worked up so as to enable the cutting to throw out roots at its foot. The end of the cold weather, early spring, and rains are the best seasons for making such cuttings. The lower section of the cuttings should be oblique, and the upper or exposed end should be plastered over with cowdung mixed with clay. In dry situations water should be given during the dry weather for the first year or more until the cutting is well rooted.

Large cuttings set direct where the trees are to grow.

31. *Small cuttings* of farásh, willow, poplar, mulberry, and the hundreds of other trees that grow well from cuttings may also be put out direct to form groves, particularly in moist places in the plains, along river banks, &c. Such cuttings (it being wished to cover the ground as soon as possible) should be put into the soil *obliquely*, so that, no part of their length being far below the soil, roots may be developed quickly. They should be put in *holes* previously made with a stake or dibber, unless where the soil is very moist or loose, such as the mud or sand on the bank of a river, for instance. The cuttings should be set out in regular lines just as seedlings are put out. But as they do not cost much, they may be put much closer.

Small cuttings put out direct where they are to grow.

Either young branches, from near the ground, or shoots from one to four years old, may be taken to form cuttings. The branchlets may be pruned off, leaving only the buds, two or three to each cutting; or they may be left on.

Bamboos may be treated in the same way, the stems or shoots being cut into sections of two or three *nodes'* or knots' length. These may be completely buried, or some of the *nodes* may be left above ground. Shoots a little over a year old should be used, as very young shoots are not sufficiently well-wooded or solid enough.

32. But, in the conditions found in the Punjab, it is generally better to keep the cuttings in a nursery until they have formed their roots. For such cuttings, well-ripened, strong shoots, one to three years old, should be selected; the still immature upper portion rejected, and the rest pruned and cut into lengths, each of which should bear two or three *buds* at its upper end. Cuttings should not be less than three joints in length, but otherwise the smaller the better for a

Small cuttings grown in a nursery: method of making the cuttings.

nursery. The cuttings should be placed in the nursery beds in fine sandy soil, and moderately, but regularly, watered. As these cuttings are to be removed and planted out, they should be set in the ground straight. The end in the ground may sometimes be cut obliquely, as, until the roots are developed, it is by this section that the cuttings can absorb the water they require. It is important that the cut should be made close to the under part of a joint, and that until the cuttings have taken root they should be protected from bright sun and hot winds as much as possible. An upright fence to the south and west will act as a shade.

Planting out cuttings from the nursery.

33. The cuttings may be planted out as soon as they have struck root. The rainy season, two or three months after they have been put into the nursery, will, as a rule, do well. As cuttings require very little special care in being packed for transport and take up little space, they may easily and cheaply be sent to long distances. For long journeys they may be tied up in bundles like seedlings, or packed in baskets lined with moss or leaves, or they may be put out in nurseries where prepared until they are rooted, and then dug up and despatched tied in bundles in the same way as recommended for seedlings.

Reproduction by Root-suckers.

Cases in which the method of propagating trees by suckers is used.

34. The method of digging up the "*root-suckers*," or the shoots which spring up from the roots of some kinds of trees, such as olives, apples, &c., &c., is not commonly used by natives of this country, except in the case of *plantain* trees, which they always propagate by this method. It is, however, the only way of propagating some beautiful exotic trees common in gardens, such as the *Millingtonia hortensis*, of which the seed is not fertile in this country.

Best way of obtaining suckers.

35. Suckers may be dug up and cut away from any tree which sends them up, but the best way to get them is to cut down an old but healthy tree, carefully fence it in, and water the ground round its stump. The suckers generally take two years or more to grow to a size fit for planting out. At the planting season, the young suckers should be carefully dug up and cut from the old roots with a sharp axe, a sufficiency of root being left to them. They can then be planted out in pits in the same way as seedling trees from the nursery are planted. They require a good deal of watering at first. Cuttings from the roots of trees that throw out root-suckers may also be used for propagation. Clean cut pieces, up to a foot long, of the roots are buried obliquely in the soil with their upper ends just below the surface. The soil should be well worked up and kept moist. This method is used for producing hedges, &c.

Propagation of *date-palms and bamboo*.

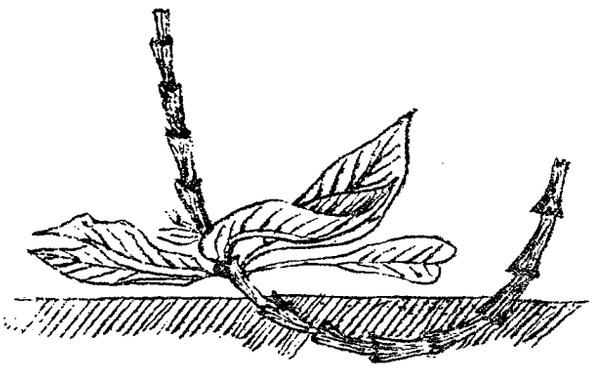
36. Date-palms and bamboos are best propagated by "*shoots*," which, though not true suckers, are often so called, and are best obtained and treated in the same way. The reasons for using this method with these two plants are that the seed of bamboos is very difficult to obtain, as that plant does not seed every year, and, when it does, many years elapse before the shoots attain their full size from seed. Transplanted bamboo roots, however, if they thrive at all, will send out full-sized shoots in two or three years. As to the date-palm, it is easily raised from seed, but does not, as gardeners say, "come true;" that is, the fruit of the seedling may be much inferior to that of the parent tree. The fruit of date-suckers, however, is the same in quality as that of the parents.

Layering.

Method of layering.

37. The method of layering is only used in this country for propagating ornamental and fruit-trees. Mangoes, loquats, &c., &c., are very generally reproduced by this method. It is, however, commonly used to propagate shrubs and sometimes large

timber trees in Europe, and might be used in India also. To reproduce a tree by this method, the branches are bent downwards until they can be brought in contact with the soil, either in the ground or in pots raised on a platform and firmly secured by pegs or by a stone on top. The soil, which should be light "*potting* soil" or mould, is heaped over that part of each shoot which touches the surface, and the tree is left alone for a season, after which most of the branches so treated will be found to have taken root at the point of contact with the soil. A slit should be cut in the branch being layered at the bent part where it touches the soil, by drawing a knife obliquely across it, on the lower *side* below a bud, upwards, for about an inch, towards the end of the branch. This slit should be kept open by placing a small stone in it.



Method of securing stem in layering.

A ghurra of water, with a small hole for a "*drip*," should be placed over each "layer" to keep the soil always moist, and during dry weather the pots should be covered up with straw, &c. Layering may be performed at any time, but the best season is at the commencement of the hot weather, when the leaves commence to come out. These rooted shoots are then cut off the parent tree and planted out like other young trees. This plan has all the advantages of planting by suckers and all those of planting by cuttings, while it is more certain than the latter method and requires less care. But trees grown from cuttings are often unsound at heart, whilst those grown from layers are sound.

Coppicing.

38. The method of "coppicing" or growing "shoots from tree-stumps" may be usefully explained here, as it is also a way of reproducing trees. "*Coppice*" (from the French word "*coupés*") means a wood or tree which has been cut down and the shoots from the stumps allowed to grow. Nearly all broad-leaved trees will, if cut down when not too old, throw out "*shoots*" from their stumps; and by cutting off the stump, or "*stool*," close to the ground, such shoots will take root separately and have an independent existence. All coppice-fellings should be made either during the cold weather, or just at its close before the new leaves come out. Pines and cedars (deodár) and similar trees do not throw out coppice-shoots.

Coppicing and pollarding.

Coppicing should not be confused with *pollarding*, which consists in cutting off the stem of a tree at a height of six feet or more above the ground. If healthy, most broad-leaved trees will after this send out shoots much more numerous than those of a coppiced tree, but smaller and mostly growing outwards, not upright as in the case of coppice. These shoots are merely new branches, while those of a coppiced tree, when cut level with the ground, become stems. Pollarding is sometimes useful in order to furnish an annual or biennial supply of fodder or small branches for fuel, but trees are in no sense *reproduced by* this operation.

Propagation by Grafting, Budding and Inarching.

39. The object of "*grafting*," "*budding*" and "*inarching*" is to produce a tree having the exact qualities of one of its parents. It very often happens with cultivated plants, as already noted with regard to the date-palm, that the seed does not

Object of grafting, and meaning of the term.

Grafting and Budding

Tongue or Whip Grafting

Crown Graftings

Cleft Grafting

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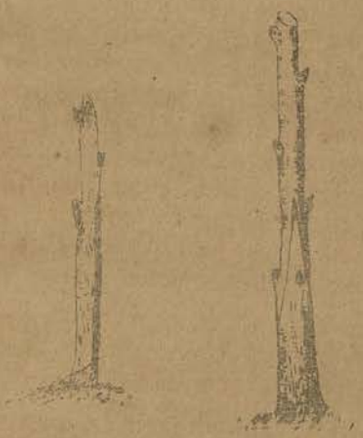


Splice & Saddle Grafting

Square Shield & Flute and Ring Budding

T. Buddings Inverted T. Buddings

Litho, at the Punjab Gov^t Press, Lahore.

produce a plant having the same qualities of fruit or flower as the parent. This result can, however, be secured by growing the tree from cuttings or layers, or by grafting, &c. The method is also useful as a means of securing early fruiting, and of strengthing a weak variety by grafting it on to a vigorous stock. The operations are understood by native gardeners in this country, and detailed instructions regarding them will be found in books on *gardening*.

Grafting, which is least understood by *málís*, consists in laying bare with a sharp knife the growing portion which lies between the bark and wood of a branch or twig and causing it to adhere to and grow on a similarly exposed portion of another tree of similar kind, air and water being excluded as far as possible until the two join to form one tissue.

Different methods of grafting.

40. There are several methods of grafting, called according to the way in which the graft is made, *viz.*, *splice grafting*, *tongue or whip grafting*, *crown grafting*, *cleft grafting*, *saddle grafting*, *&c.* These methods will be understood from the accompanying illustrations which are taken from the "Manual of Sylviculture" recently published by Mr. E. Fernández of the Indian Forest Department:—

Woodward ("Gardening in India"), page 64, says:—"*The essential part is to cut the scion and stock so that the inner bark of both may be brought together, because it is at this point that union takes place. The proper season for grafting is immediately before fresh growth takes place. Now, as many trees in this country have two growing seasons, a rainy season and a hot season growth, it is preferable to graft near the middle of the rains; but this question can only be answered decisively on examination of the individual tree to be worked upon. The scion must be of firm, well-ripened wood, with dormant but plump buds, and the stock must be ready to start into growth. This condition may be known by the buds swelling. The most generally useful form of graft is that known as the 'tongue graft.' It is made as follows:—If your stock and scion are nearly the same size, cut off the head of the stock, then cut it down near the centre for about one inch or more in proportion to its size, take a slice from the outside of one of the halves, working the knife gradually inwards so as to leave the tongue with the end as thin as possible, make exactly the same cuts on the scion, and the two parts should then fit together accurately, and must immediately be bound together with a tape, and the union covered with well-tempered clay or grafting wax. The plants must then be kept in a frame heated slightly by a layer* 18 *inches deep of cowdung and leaves mixed in equal proportions. The best* season for grafting *is the spring, when vigorous growth is commencing.*"

Grafting clay.

A good mixture for covering grafts and other wounds on plants commonly used by málís consists of one part of bullock's dung and two parts of clayey soil carefully kneeded together, with the addition of some finely chopped straw, fibre or hair. This forms an excellent covering. The best earth to use is the kind used by the people to smear the walls and floors of their houses.

Inarching.

Inarching or grafting by approach consists in bringing two living trees together and causing a union by cutting a portion of the wood and bark from each, so that the inner bark of both can be made to touch accurately. The two wounded surfaces are then tied together and clay applied to keep out air. The cut portions should in every case be made as closely as possible.

"*This operation can be performed at any season, but is most successful when the trees are in vigorous growth. It is by this means that the famous Mazagon mangoes are chiefly propagated.*

"*This operation is extremely easy, very litle skill being necessary. It is usually performed between a large tree of a superior variety growing in the ground and a small seedling of the same species growing in a pot. The plant in a pot may be elevated in the branch of the large tree by tying it to a thick branch, or a stage may be erected on which a large number of pots may be arranged. Some of the grafting stages at Ganesh Khind had* 5,000 *plants in pots inarched to one tree. The only difficulty is to see that the plants in pots are regularly watered, the soil must be kept moist, and from the position the pots are apt to be neglected.*

Budding.

"*Budding is a variety of grafting, and it is a very simple yet delicate operation. It consists of removing a bud from one plant and making it grow on another, which must be of the same family and closely related, although it may yield fruit or flowers of an inferior character; for instance, we can bud an orange on a lime tree, and a peach on a plum tree, but we cannot bud a rose on an orange tree.*" According to the shape of the piece of bark and the manner in which it is worked on to the stock, there are four principal methods of budding, *viz.*, "T, or ordinary shield, budding," "*square* shield budding," "flute budding," and "ring budding." These methods will be understood from the accompanying figures which are taken from Mr. Fernandez's book. Woodward says:—"*In budding, a single bud is cut from the twig of the plant to be propagated; if there is a leaf attached to the bud, the blade of the leaf should be cut off. Then by inserting the knife about half an inch above the bud and cutting slightly inwards and downwards bring the knife out about half an inch below the bud. This removes the bud with a small shield of bark attached*

and generally a little bit of wood adhering to the centre of the shield. This bit of wood should be removed with the point of the knife, a longitudinal slit a little longer than the shield of the bark should then be cut in the bark of the tree to be worked on, and at the upper end of this slit a small transverse slit made to facilitate the raising of the bark; so that the cut is T-shaped. In making this cut care must be taken not to go deeper than the bark. If the wood is cut into, an obstruction is formed which causes injury. This point is of special importance in budding the orange tree. Then, taking hold of the cut corner of the bark with the point of the knife, raise the bark straightly, and, inserting the handle of the knife between the bark and the wood, raise the bark on both sides sufficiently to allow the bud and its little shield of bark to be slipped in; then close over the cut edges of the bark and tie with tape or worsted thread, or, perhaps better still (because not liable to contract or expand by change of weather), the sopat or strip of fibres obtained from the stem of a plantain tree."

"The proper season for budding is at any time when both the tree which yields the bud (the scion) and the tree which receives it (the stock) are growing freely."

As soon as the scion has become united to the stock, the ligature should be removed and fresh one put on somewhat more loosely than the one taken off; and in the case of budding the portion of the stock above the bud should be cut off as soon as the latter begins to grow.

THE FORMATION OF GROVES AND AVENUES.

Selection of Nurseries.

41. Although groves of trees may, in some cases, be formed by means of direct sowings, or by cuttings set direct without the aid of a nursery, they will generally require to be planted with young trees reared in nurseries, and nursery-grown trees are also required for planting up avenues of trees.

In nearly all cases, then, the first operation in carrying out a scheme for the formation of groves and avenues will be the selection of sites for the nurseries that are required.

Temporary nurseries.

42. Nurseries should, as a rule, be made as near as possible to the place where the trees are to be planted. For first operations, such as establishing groves or lines of trees along new roads and for planting operations in the hills, where transport is very difficult, and where the climate and vegetation varies with each elevation, it will generally be advantageous to make small nurseries, capable of supplying the number of plants required, at each grove or along each road or section of road to be planted. Such nurseries are merely *temporary* tree gardens. But this principle should not be carried too far, as nurseries, if numerous and scattered, are liable to be neglected.

Permanent nurseries.

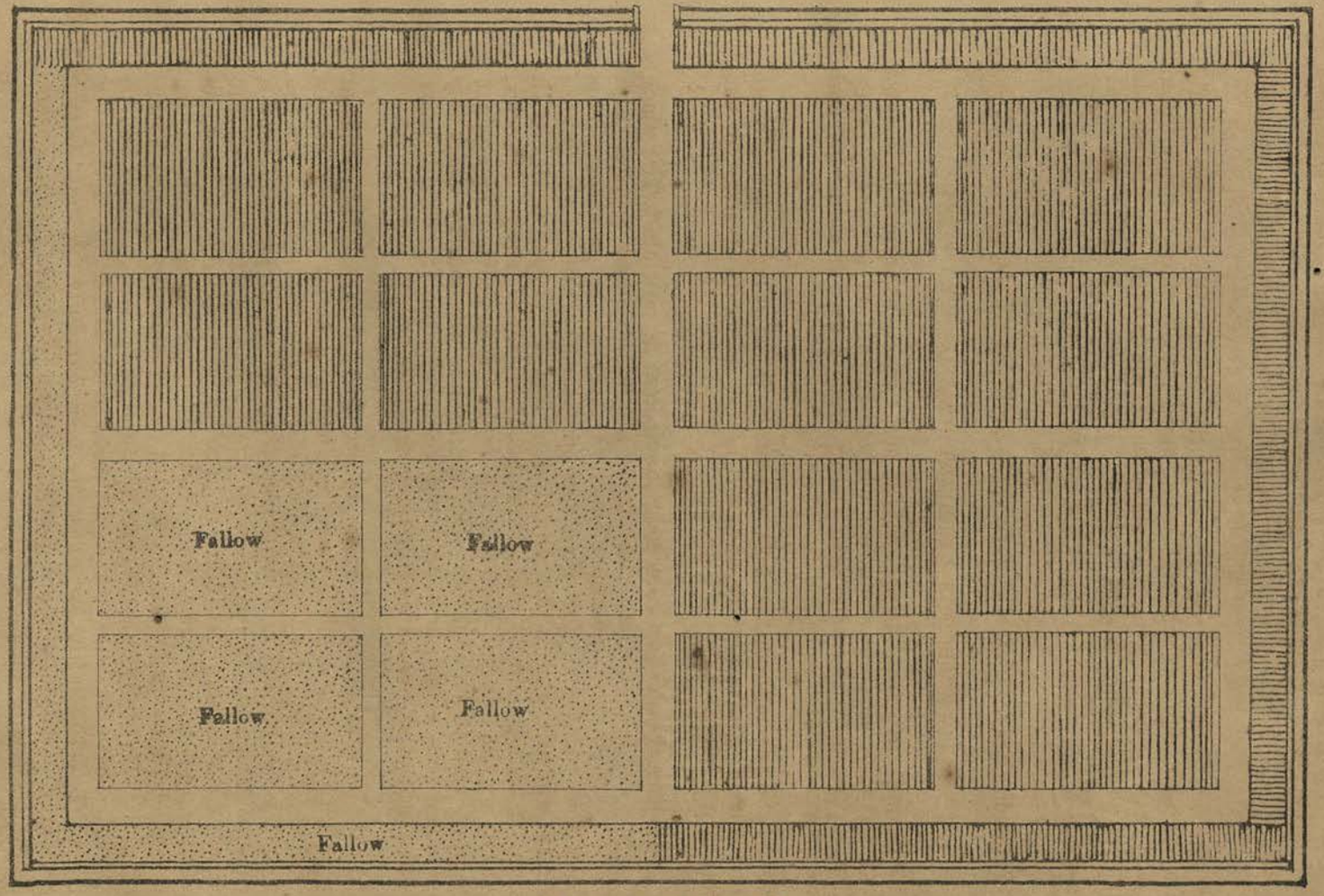
43. But it is also often desirable to establish *permanent* nurseries at central places for the continuous supply of the seedlings required in the neighbourhood. As the growing of nursery seedlings of different kinds requires great care, skill and a settled management, and the preparation of the ground is expensive at the outset, it is always best, where seedlings are liable to be constantly required, as for instance to keep up the avenues and groves of trees round a station, to establish a permanent nursery for these works at a conveniently central place. The same general rules apply to both sorts of nurseries. The young trees in temporary nurseries have to be sown and tended with the same care as in permanent ones. But the latter are naturally more carefully laid out, better and more permanently fenced, and are generally larger; in other respects there should be no difference between the two.

Selection of site for a nursery.

44. A good site for a nursery must fulfil several conditions. It must be conveniently situated, both as regards supervision and the areas it is to supply with seedlings; it must be on a good soil, and, in the plains, it must be so situated that it can be easily, cheaply, and abundantly irrigated. This latter consideration is of the first importance in a dry district.

PLAN OF A PERMANENT NURSERY.

AREA 3½ ACRES.



AREA STATEMENT.

Border	...	16,096 sq. ft.
Main road	...	25,344 „
Central six foot paths	...	7,824 „
Sixteen plots, each 6,000 sq. ft.		96,000 „
Total area	...	14,72,64 „
Ditch	...	5,200 „
GRAND TOTAL	...	1,52,464 „

...he at the Punjab Government Press, Lahore.

Where all these conditions cannot be fulfilled, the least important must be sacrificed. In the plains, for instance, in order to secure adequate irrigation, it might be justifiable to establish the nursery on an inferior soil or at a long distance from some of the works.

Size of nursery.

45. Before selecting the site, it will be well to determine, at least roughly, the *size* of the nursery required. This depends of course on the work it will have to do, that is, the *number* and the *age* of the seedlings to be supplied annually.

Space *according to the number of years the young plants have to remain* in the nursery must be provided. For instance, if the seedlings are not to be planted out until they are more than three years old, space would have to be provided for three years' stock of seedlings, of one year, two years, and three years old, respectively. Provision must be made for the roads, which occupy a relatively large area in a well-planned nursery, for trenches or paths between the beds, and also for allowing a portion, one-third or one-fourth, of the whole area to remain *fallow* in rotation every year.

The success of the eventual planting to be done will depend chiefly on the young plants being healthy and well-grown. This requires a good nursery and sufficient space. On the other hand, as the cost of clearing and laying out a nursery at the outset is very considerable, it is not advisable to make the area *too* large. Time, therefore, given to calculating the size of the required nursery will be very profitably spent.

Calculation of the area required for a nursery.

46. The calculation of these areas can best be done in some such form as the following, which also enables a record to be made of the work to be done. This should always be laid down from the outset :—

Working Scheme for a Permanent Nursery.

Trees to be propagated.	Number.	How to be propagated.	*Quantity* of cleaned seed required.	[Seed when to be sown, or cuttings, &c., when to be set.	Seed how to be sown, or cuttings, &c., how to be set; distance apart, &c.	Area of seed beds required.	Plants how long to remain in seed beds before transplanted.	Plants how to be planted out in nursery lines, &c.	Area of nursery lines required.	Age at which to be planted out.	Total area of nursery lines required.	Area to be left fallow each year.	Area required for roads, &c.	Total area of nursery required.	Remarks
						Sqr. feet.			Sqr. feet.		Sqr. feet.	Sqr. feet.	Sqr. feet.	Sqr. feet.	
Sisan	12,000	Seed	2 Seers	April	In drills 1 foot apart	400	9 Months	In raised trenches 1 foot apart.	12,000	2 Years	24,400				
Farásh	6,000	Cuttings	Do.	March	6 inches apart in trenches 1 foot apart.	...	...	...	6,000	4 Months	6,000				
Kikar	10,800	Seed	4 Seers	July	In drills 1 foot apart.	300	9 Months	In raised trenches 1 foot apart.	18,000	2 Years	36,300				
Pipal	6,000	Cuttings	Do.	March	6 inches apart in trenches 1 foot apart.	...	...	...	6,000	4 Months	3,000	24,000	33,000	146,700	For plan *see* accompanying sketch.
Country mango ...	2,000	Seed	1 Maund	July	In boxes or pots ...	...	9 Months	In raised trenches 1 foot apart.	2,000	3 Years	6,000				
Ber	6,000	Do.	30 Seers	April	In trenches 1 foot apart	2,000	Until planted out.	Not to be transplanted.	...	16 Months	2,000				
Plums	3,000	Cuttings	Do.	March	Ditto ditto ...	...	...	...	3,000	4 Months	3,000				

Planting out Trees from the Nursery.

47. The size trees should attain before being planted in the places where it is intended they should grow depends chiefly on the situation in which they are to be planted. For groves fenced in and free from jungle, when the soil is good, young seedlings under 2 feet high in the plains, and 9 to 12 inches high in the hills, may be used. *Isolated road-side trees should not as a rule be planted out before they are 5 feet high;* the larger and taller the better, so long as they can be *lifted* without their roots being injured. Half the failures in road-side planting are due to the use of too small seedlings or of trees which have not had their roots formed by being transplanted in the nursery; such seedlings have long tap-roots, and as this has to be docked, they are put out without any roots to speak of. *Trees planted in the streets of towns require, as a rule, to have a stem free of branches 8 or 10 feet high.*

Size and age at which trees are to be planted out.

The age at which young trees attain these heights depends on the kind of tree. In the plains, as a rule, the common kinds of trees may be planted out in groves when 1 to 2 years old, and along road-sides at from 2 to 3 years old, or younger, if not less than 5 feet high. In the hills, where growth is slow, the plants are sometimes kept in the nursery for a much longer time.

48. In the plains, in irrigated ground, the best season for planting out seedlings is either during the cold weather—after the frosts, but *before* the young buds appear—or during the rains. In the hills, and wherever rainfall has to be depended on, the rainy season is the most suitable time. *Large* trees are, however, best transplanted during the cold weather.

Season for planting.

49. Only healthy plants should be taken from the nursery for planting out. This is one of the most important points connected with planting. *All* weakly or sickly plants, if not weeded out already, should be rejected and either thrown away or left for another season. The best time to ascertain whether plants are strong and healthy or the reverse is in the *summer before* the transplanting season, when the young trees are in full leaf. At this season the bark of healthy young trees is clear and free from the "scaly" appearance of sickly plants, and the underbark is a healthy transparent green and full of sap.

Selection of plants in the nursery.

50. Plants may be lifted and transported either with or without the soil round their roots. The precautions to be taken in lifting the seedlings from the nursery beds have already been explained. The most important point is to see that *the roots are not injured.* Transplanting with earth is always to be preferred when not too expensive, as the roots remain in the same position as when growing in the seed beds, the chief dangers are prevented, and the young plants resist the effects of the change, and of frost and heat, &c., much better. Where the plants have to be carried long distances, the weight of earth makes the transport expensive, and sometimes the soil is so light and friable that the earth will not adhere to the roots. There is also the danger of the soil not being completely filled in between the ball of earth and the sides of the hole it is planted in, and the roots becoming exposed in consequence.

Lifting the young plants with and without earth.

51. Seedlings taken up with a ball of earth round their roots can be conveyed short distances packed in baskets and carried on men's heads or in carts. The main difficulty will be to prevent the ball of earth breaking away from the roots. If the soil is very sandy or friable, this will be impossible; so that, in such cases, it is no use attempting to transplant with earth. The plants should be packed closely together, and the small intervals between the individual earth balls should be filled in with good soil or leaf mould, or each ball may be bound in leaves or grass. For longer journeys the earth ball will require to be bound with matting and the plant secured from injury.

Transporting plants.

But, if care is taken, plants can be transported for a week or more without earth round their roots, and if the plants are only to be exposed for a short time it will suffice to lay them more or less loosely in baskets, with moss or leaves round their roots; when exposed for longer periods they may be tied in bundles, bound round with the twisted stems of some fibrous grass or creeper or with cords. In the centre of each bundle there should be a core of damp moss and leaves for the plants to lie against, and large fern leaves or twigs or matting should be bound over the bundle and project over the roots, so as to protect the whole contents.

Plants should not be kept out of the ground longer than is absolutely necessary, as the smaller roots quickly dry up. While on the ground, waiting for being put into the pits, they should be kept in a shady place lightly covered with earth and watered in dry weather. Where possible, no more plants should be lifted from the nursery beds than can be planted the same day. If, in transplanting, any roots are injured, they should be pruned off with a sharp knife. But it is not wise to prune roots much. When necessary, the small branches may be cut off, and any awkward-looking branches should be removed. Some plants may be completely cut back, as the roots, when planted, will throw out strong shoots. Bamboos may be cut down in this way to one or two joints. Conifers (firs and pines), as a rule, do not bear such cutting back. Pruning should be done before the plants leave the nursery, as this will lessen their weight and, therefore, cheapen their carriage. The work of transplanting should be done in an orderly manner—one gang of coolies or one man digging the plants from their beds, a second party or man carrying the plants to the planting ground, and a third placing each plant at the mouth of the pit it is to be planted in. Of course where the distance is great carts should be employed.

Different ways of planting: "pit," "furrow," and "notch" planting.

52. Young trees may be put into the ground in several different ways. They may be planted in *pits*, with or without the ball of earth adhering to their roots and with or without manure round their roots; or, if small, they may be simply placed in holes quickly made by driving a stake into the ground, or into a *notch* or *slit* made with a single blow of the hoe. In very dry situations and soils they may be planted in *trenches* or *hollows*, or in damp or swampy ground, on mounds or on ridges of earth. These methods are known in Europe as "*pit*," "*furrow*," and "*slit*" or "*notch*" planting, &c.

Pit planting.

Pit planting is the method most generally used and most successful in this country. The pits should be prepared before the planting is commenced, so as to enable the work to be carried on uninterruptedly, and the seedlings placed in the holes dug for them immediately on reaching the ground. The size to be given to the pits depends, of course, on the size of the plants. It is necessary to make the pits sufficiently large to readily take in the ball of earth, or, if the trees are planted with naked roots, of such a size that the roots of each plant may be placed in the pit in their natural position without being doubled up. In the case of small plants, the diameter of the pits should be very nearly the same as the height, including the roots, of the young tree to be planted. For trees of four or five feet high, such as are usually planted along roadsides, &c., pits three feet deep and of nearly the same diameter are required. The pits should be dug as long before the planting is commenced as possible so that the soil may *weather* before being placed round the roots, and the upper soil or mould, if any, thrown on one side at the time of digging so as to be ready to be filled in round the roots. Where the plants are put in with the ball of earth adhering to their roots, care should be taken that the surrounding soil is well pressed in; otherwise the ball, on contracting, will leave the roots exposed in a crevice between the two surfaces.

Furrow or trench planting.

In very dry situations, particularly on sloping ground, trenches instead of pits may be dug, as the trenches catch any rain water falling on the surface. But the digging of the trenches deep enough for large plants is expensive.

Mound planting.

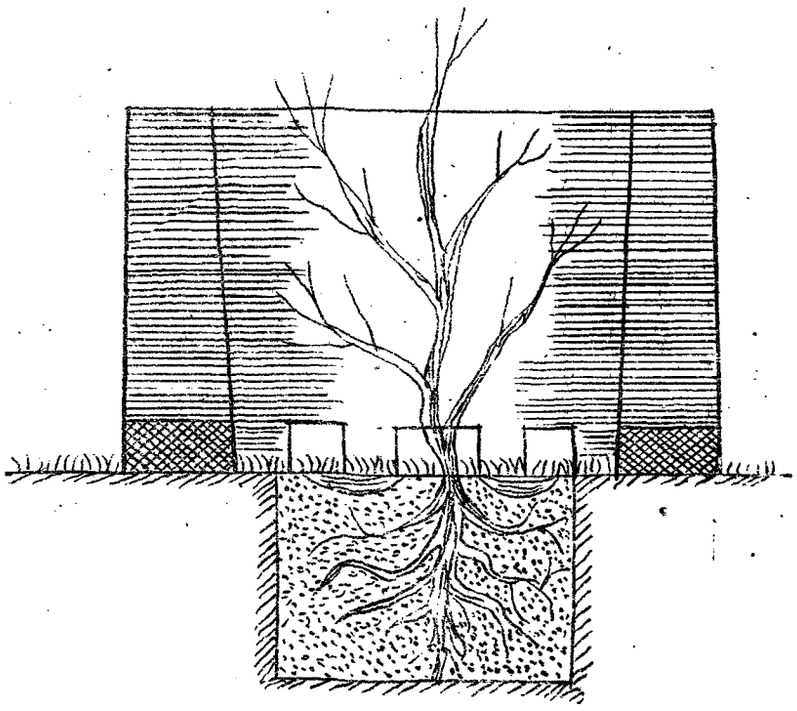
In damp, swampy places and in depressions, which are liable to become filled with water during rainy weather, mounds or ridges may be raised and the trees planted on them.

Hole and notch planting.

Hole and notch planting are only useful in moist, loose, and sandy soils in places where trees grow very readily.

Method of putting plant in ground.

53. In all planting operations, the plants should be buried to the "*collar*" of the stem; that is to say, as deeply as they were in the ground before being transplanted, and in the case of large plants, in the same position as regards the points of the compass as they were before being removed. There should be two or three planters: one to hold the tree in its proper position, with its *collar* at the level of the ground and its roots hanging down in their natural position; the others to shovel the earth in all round, taking care that it is broken and not in great lumps. The earth should be slightly heaped up round the stem and hollowed out up to the edge of the hole, so that, when irrigated, the stem may stand in a little island in the middle of a lake. These operations are expensive, but the money will be well spent.



Section showing tree planted in pit with mud wall fence.

Distance between the plants.

54. For groves, the closer together young trees are planted the better they will shelter one another and the soil, and there will be less likelihood of *blanks* occurring afterwards. There will be no difficulty or expense in thinning out the less robust plants as the stronger ones grow and require room to develop. But the closer the trees are planted the more expensive the operation becomes at the outset. To plant an acre of ground with young plants one foot apart requires 43,560 plants and the same number of pits; while, if planted nine feet apart, only 538 plants and pits to hold them would be required.

But many kinds of trees, unless grown in numbers close together while young, never develop well. Fruit trees, on the contrary, require to be planted at wide intervals apart.

Young seedlings of the common kinds of trees planted in lines, in pits or along trenches, nine or ten feet apart, with intervals of four or five feet between the plants, will succeed very well, and form excellent groves if properly looked after. Where there is a dense jungle growth, such as very often springs up in irrigated land in the plains, trees not less than three feet in height should be planted.

Road-side trees and avenues.

55. Trees along road-sides and avenues are generally planted at thirty feet apart. *Avenues of trees to be effective should be all of one kind of tree.*

56. The number of trees required to plant up an area of one acre or a mile of road, and the number of pits that have to be dug, are given in the following tables :—

Number of trees required to plant up an area or length of road.

Average number of trees required to plant one acre at various distances apart.

Distance between lines in feet.	DISTANCE BETWEEN PLANTS IN FEET.											
	1	2	3	4	5	6	7	8	9	10	11	12
1	43,560											
2	21,780	10,890										
3	14,520	7,260	4,840									
4	10,890	5,445	3,630	2,722								
5	8,712	4,356	2,904	2,178	1,743							
6	7,260	3,630	2,420	1,815	1,452	1,210						
7	6,223	3,112	2,075	1,556	1,245	1,038	889					
8	5,445	2,722	1,815	1,362	1,089	908	778	681				
9	4,840	2,420	1,614	1,210	979	807	691	605	538			
10	4,356	2,178	1,452	1,089	871	726	622	544	473	430		
11	3,960	1,980	1,320	990	792	660	566	495	440	396	360	
12	3,630	1,815	1,210	908	726	605	518	454	403	363	330	303

Average number of trees required to plant a line one mile long at various distances apart.

Distance between plants in feet.	Number of plants required or pits to be dug.	Distance between plants in feet.	Number of plants required or pits to be dug.	Distance between plants in feet.	Number of plants required or pits to be dug.	Distance between plants in feet.	Number of plants required or pits to be dug.	REMARKS.
10	528	15	352	20	264	25	211	Where both sides of the road or avenue are to be planted, or more than one line of trees are put out, these figures will require to be multiplied by the *number of lines* planted.
11	480	16	330	21	251	26	203	
12	440	17	311	22	240	27	196	
13	406	18	293	23	230	28	189	
14	377	19	278	24	240	29	182	
...	...	...	...	...	...	30	176	

57. For planting in streets, large-sized trees, 10 feet to 15 feet in height and 3 to 4 inches in diameter, are best. They should be prepared for their destination in the nursery by being transplanted several times, so that they may have manageable

Planting in streets of towns.

bushy roots, and by being pruned and trained, so as to have straight, clean stems with good leading shoots. Such trees require to have very large deep pits made to receive them when being planted. If the soil is very hard, as it generally is in streets, good soil brought from elsewhere should be filled in round the trees. In European towns, in street-planting, drain pipes, made with lap joints, so as to prevent the roots entering them, are generally laid along the sides of the pits to drain off water. Well-balanced trees, with perfect roots, should be chosen, and it is a good plan to pour water into the pit before putting the tree in. The trees should of course be fenced in, as in the case of all road-side trees. When young trees of large size are specially reared for planting out in cities, it will be well to grow them, when they can be sufficiently irrigated in that position and the heat is not too great, on high ridges about 3 feet apart. Growing in loose earth on ridges, they will be much easier to remove from the nursery than if planted in the level ground, and much less expensive. This is important when the size of the trees is considered.

Transplanting large trees.

58. When large trees, of 20 to 30 feet high and weighing as many maunds, have to be transplanted, as is sometimes necessary or advisable for street-planting, a machine will be required sufficiently powerful to lift the trees with their roots uninjured and in the same condition as young seedlings are transplanted from the nursery. The following common trees bear transplanting when of a large size very well :—

Kikar, siris, nim, bakain, safed or dun siris, kachnár, simul, sissu, bamboo, cypress, pangara, banyan, pipal, mulberry, olive, &c.

Obstacles to Tree-growing.

Ground overgrown with jungle.

59. One of the most common obstructions to tree-growing is a dense growth of jungle, so strong as to choke the young trees planted. In the plains the most common growth is *kána grass*. Trees can seldom grow unless this grass is kept down while they are young. The best and cheapest way is to dig out the roots with the "*vahaula*" spade. The same treatment should be applied to all other jungle growths. It will be best in such land to plant stout young trees 3 feet high.

In the hills the ground is often covered with a dense growth of *indigofera, calaminthies*, ferns, &c. Lines or strips cleared through these, if kept clear until the plants top the jungle, may sometimes be sown direct, but it will be infinitely the best to plant them up.

Barren soils and kankar beds.

60. Kankar beds, if within 3 feet of the surface, will have to be dug out. But the whole of the kankar need not be dug. Pits a little larger than usual should be made right through the kankar bed, if possible, and filled in with good soil. Trees along road-sides will grow very well if planted like this. *Usar* and *reh* soils which contain a great deal of salt, can, if irrigated, be used for tree-growing.

Covering unsightly patches of barren soil.

61. Unsightly soils of this sort in a station or compound can be clothed with grass very quickly by ploughing, manuring, and slightly irrigating them.

The white salt on the surface generally shows that the water is coming up to the surface and evaporating, and as the fertility of a soil is increased by water passing down through it, increase of water at the surface or deep draining will generally make the deposit of salt disappear.

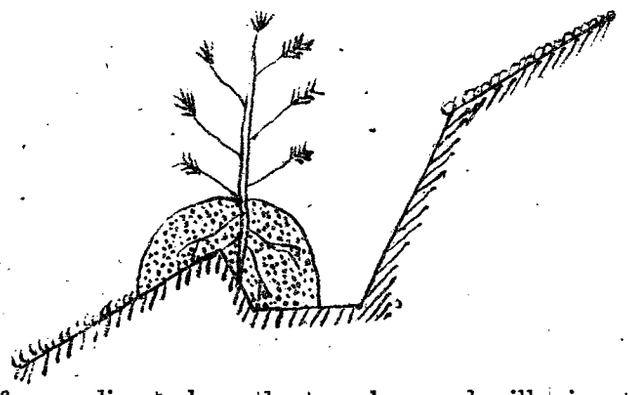
62. In *marshy soils* and depressions in which water stagnates, large cuttings, tall enough to be above the highest flood, will grow well. Where water lies for any length of time, mounds should be made and seed of any trees suitable to the climate and situation sown on the mounds; or trees may be *planted* in the ordinary way in pits dug in them. Trees will generally grow very well in such situations.

Marshy soils and depressions.

63. It is often desirable to plant broken ground, parts of which may be of an extremely precipitous nature. It is impossible to irrigate such ground. But, except in the arid regions in the south of the Punjab, much may be done for such land by fencing it, so as to exclude grazing and browsing animals of all sorts, and then digging level horizontal trenches at short distances apart. These trenches will catch whatever rain falls, and may be either sown or planted. Trees may often be successfully reproduced by this method where the rainfall is not under 20 inches.

Clothing broken ground and precipitous places in the plains with vegetation.

The trenches should follow the *contour* of the ground, and the earth should be thrown on the *lower side*, so that the trenches may catch as much water as possible. The good soil on the upper edge should be broken down and brought about the roots of the plants. In any case, the ground, if treated in this manner, will become clothed with green grass, and its unsightliness be diminished. *Sanatha* will grow very well if sown direct along the trenches, and will give the ground all the appearance of a young plantation. Of course in the arid districts, where the rainfall is less than 10 inches, nothing can be done without irrigation.



Tree-growing on Canal Belts.

64. A certain breadth of land has been acquired by Government along the banks of the great canals which irrigate the "Bar" lands, where, without water, trees cannot be grown. Much useful work has been done in the way of forming plantations on these belts, so as to utilize the water that percolates from the canals. But, although such situations are excellent for forming *avenues* of trees, it should be understood that much of the land along canals is not fit for *plantations*, and that narrow-planted strips are generally unsuited for forest treatment and are in all cases difficult and expensive to manage.

The importance of canal plantations exaggerated.

The canals are not in any way designed for being planted on their banks, except with a line of trees on either side for shade. Where the canal is *in cutting*, the whole, or very nearly the whole, area of the "belts" on either side is occupied by the "*spoil*," the surface of which is too high to be irrigated or for the roots of the trees to get much of the water which may percolate from the channel. Where the bed of the canal *is level* with, or above, the natural surface of the ground, the soil of the belts has to be dug out to form the banks, and the area is not therefore suitable for planting.

On this subject Mr. C. Tickell, of the Irrigation Branch, writes:—

To take an actual case, a new canal is about to be constructed from a little below Jhelum. It will start with a bed 180 *feet wide; near the head it will be in* 20 *feet of digging, at the* 10*th mile the digging will be about* 10 *feet, and about the* 20*th mile it will work out on to the surface.*

Supposing the height to which the spoil is to be dressed is limited to 10 *feet, we shall then have spoil-banks about* 190 *feet wide, measuring about* 45 *acres to the mile. When we come to the* 10*th mile, we find half as much digging and the spoil occupying only half the width ; we shall then have about* 25 *acres per mile under the same conditions. The spoil-banks, consisting of earth freshly thrown out, can generally be successfully sown with the seeds of any of the common hardy trees, such as kikar or phulai. But it will probably be very difficult to renew these plantations, as, when the time arrives, we shall not have freshly-made spoil, but a hard, dry, raised platform* 15 *to* 20 *feet above the canal surface, and these are conditions under which trees will not coppice.*

When the canal is in heavy digging, then the establishment of the plantations is not difficult, but in some cases their renewal is.

When we get to 3 *feet of digging, it will be found that the earth excavated in the channel will just about be enough to make up the banks to their full height of* 9 *feet, and we shall have no spoil ; but we shall still acquire a strip of land on either side to provide earth for repairs to banks, &c. Say* 100 *feet outside the banks (and excluding the boundary roads) is taken up : we shall have about* 25 *acres per mile of plantation on the ground surface and commanded by the canal water. We should here probably sow seed in trenches, but we should still keep to a kind of tree which will grow without irrigation eventually, as we do not want to have to water them after they are a few years old. Here also the plantations will do fairly well, as the conditions are such as will exist in moderately elevated land, but the cost of sowing will be very much higher than that of broadcast sowing on the spoil-banks.*

When the bed of the canal is level with the ground, the strips of land taken up outside will have to be dug out 3 *to* 4 *feet deep to make up the banks. The available plantation land, therefore, consists of pits several feet deep situated in low land and with the canal water surface* 8 *or* 9 *feet above the level in which the trees are growing. These are conditions under which few trees succeed Such plantations are in most cases full of reh or kankar, or both, besides being often under water. As the canal gets narrower and splits up into still narrower branches, the excavation from inside supplies all earth, and the necessity of outside digging or borrow pits becomes more frequent, so that lower down the plantations become patchy ; besides this, they get narrower as less land is taken up ; perhaps* 50 *feet wide is available for them, or* 10 *or* 11 *acres only per mile.*

Unless the plantations are established when the canal is first constructed, their establishment afterwards is costly, as fencing is necessary as a rule owing to the increased number of cattle after the canal begins to irrigate, and two miles of fencing is required for every 10 *acres fenced, besides gates and cross-fences at all bridges crossing the canal.*

The Canal Department use up a great deal of the canal forest produce for burning lime and bricks, for repairs, and for roofing out-offices, huts, &c., and for making crates, &c. In such cases the value is debitable to the works, and credit given to 'Plantations.' A good deal of wood is also sold.

Very little establishment is charged to the canal plantations, as the Overseers look after them in addition to their other duties. They thus pay their way, and yield a handsome profit besides. Doubtless more yield could be got out of the land if more attention were paid to the work, but it is doubtful whether the dividend they pay could be largely increased.

Growing Fruit Trees.

Importance of cultivating fruit trees.

65. Attention has frequently been called to the importance of extending the cultivation of fruit trees in the Punjab, both as a source of income and for the health and enjoyment of the people. Fruit trees, besides the shade they afford, furnish an annual yield of fruit in a comparatively short time after being planted. Small orchards could easily be established near villages by the villagers themselves, at very little expense as regards cultivation, irrigation, or protection. And it is probable that, if a supply of grafts or cuttings of good but hardy varieties of fruit trees were kept for free distribution to the villagers at public nurseries in each tahsíl, such village orchards would soon be a familiar sight in the Punjab.

Dates, oranges, limes, lemons, figs, peaches, grapes, plums, *guavas, loquats, phalsas,* mulberries, mangoes, plantains, pomegranates, *papayas, amrak, lasúra, jáman, amlok, ber, karaunda,* &c., can be grown in the plains ; walnuts, hazel-nuts, apricots, cherries, plums, apples, pears, grapes, peaches, and Spanish chestnuts are amongst the best known of the fruit trees which can be cultivated in the hills.

66. Mr. B. H. Baden-Powell, in his descriptive catalogue of the Government Gardens at Lahore, gives the following excellent short rules for the cultivation and management of fruit trees :—

"In starting an orchard, it is necessary that the soil should be good. On saline or *kalar* soils fruit cannot be grown, at least not until the soil

has been cured. Manure and water are essential. The soil must be well or repeatedly dug or ploughed up.

"When the site of an orchard is not already protected (as in a city or station garden), it must be surrounded with a thorn hedge, or, better still, a mud wall.

"Often it will be found desirable in villages to grow a group of fruit trees near wells, or on edges of cultivated fields. But orchards will be found best, and their size should be according to the ground available. Fruit trees benefit by each other's shade and society, and manuring and watering can be more cheaply, easily, and regularly managed, to say nothing of the protection of the fruit.

"*Planting.*—Fruit trees may be planted in the middle of the rains, but best of all during January and the first-half of February, *not later.* In the cold season the trees can be carried with safety, sometimes without earth; moreover, as the sap begins to rise shortly after planting, any accidental injury to the roots will quickly heal. Fruit trees must be planted like any other trees, and *so far apart that each tree has room to develop freely.* Trees should not, as a rule, be less than 12 feet apart, and 25 to 30 feet apart is often necessary. Rows or lines are good, as water-channels can easily be dug.

"*Watering.*—Water must be given regularly. Fruit trees must not be drenched at one time and left dry at others. Especially when the leaves are budding and again when the young fruit is "setting," plenty of water should be given. Whenever water is given, let it be a fair and full supply, not in dribblets: when the fruit is *getting ripe,* water only moderately, or the flavour of the fruit will be spoiled.

"*Manuring and Management.*—In the cold season it is desirable to dig well about the roots, and leave the upper roots exposed for a time. Then, after an interval, fill in the earth and treat with liquid manure, if it can be procured, once a week, till the flowers begin to show. If it is convenient to make liquid manure, then some of the earth may be removed, and its place supplied by dry manure, which should be well dug into the soil and mixed with it.

"*Pruning.*—This can only be learnt by experience; but two points can be remembered—(1) that the object is to produce *fruit,* not *wood;* hence superfluous branches should be cut off, leaving what are necessary only as evenly and symmetrically distributed as possible; (2) that the branches should be so disposed that light and air may penetrate through the head of the tree, no branches in the middle being smothered and oversheltered. Long straggling twigs and branches will also be shortened. Pruning is done *only* before the sap rises at the end of the cold season.

"Some attention has recently been attracted by the experiments of Mr. Kynaston in improving the fruit-bearing power of trees. Mr. Kynaston points out that the tree has, besides the "tap" or vertical root, or the strong side roots, a multitude of smaller fibrous roots, especially proceeding from the base of the stem, and that these convey nourishment to the trees, and thus promote the formation of fruit, instead of allowing the greater number of *flowers* to fall off and come to nothing, as they do in ordinary trees. He accordingly, in winter, digs a circular trench about one foot deep round the tree at a distance of 2, 3, 4 or more feet from the stem, according to the size of the tree and the probable spread of the *long lateral* roots, and this trench of course cuts the long roots. If the tree is young, the sharp spade edge does the work; if older, a knife must be used. The effect of the root-pruning is said to promote the growth of the *small fibrous* roots near the stem. The trench is filled in again, and the whole soil around the tree dug up and manured. Mr. Kynaston claims to have restored old trees, and to have cured those that from some cause or other would not bear with the greatest success."

IRRIGATION.

Labour required to irrigate trees from wells.

67. Except in the naturally irrigated areas along the great rivers or along canals, trees cannot be grown in the plains without being irrigated, at least while young. In the lower hills and in some of the plains districts, the *total* annual rainfall is more than the trees require. But this rainfall is so unevenly distributed that irrigation is necessary during the hot dry weather until the trees are some years old and have got their roots deep into the soil.

The enormous labour involved in raising the water required for irrigating trees from the deep wells generally found in the Punjab can hardly be realized. Crops require to be irrigated to a depth of from 10 to 30 inches in the course of one season, and it may be assumed that young trees do not require less water. One inch of water on the surface of an acre (43,560 square feet) measures 3,630 cubic feet, and weighs 2,759 maunds, or almost exactly 100 tons. In order, therefore, to irrigate a grove of trees an acre in extent by means of well water, it is necessary to raise *at least* 30,000 or 40,000 maunds or 1,000 to 1,200 tons (and possibly very much more) of water from whatever depth it may lie at. This must always be expensive. But without sufficient moisture the richest soil will be sterile, while with an adequate supply of water the poorest soil will grow forests.

Therefore, before undertaking tree-planting operations in the plains, the first and most important point to consider is how the trees are to be irrigated.

Canal irrigation.

68. The works connected with canal irrigation are thoroughly understood in those districts in which they are required. As a rule, water from canals can only be obtained during a limited number of days in the year. When starting anything like a large plantation, this number should be ascertained from the authorities and arrangements be made accordingly. In digging the channels, the bottom should, as a rule, be twice as broad as the depth, and in average soil the slope of the sides should be 1 in 1. As digging these channels is expensive, the size should be calculated, so that the channels may be able fully to discharge the quantity of water required (allowing for loss, silting up, and so forth), *but not more*. A discharge of 1 foot a second for 24 hours will irrigate the surface of an acre to a depth of about 24 inches.

Distribution of water over ground.

69. The best way to distribute water over the surface of the ground in planted areas is by parallel trenches. Native gardeners generally flood the whole surface of the soil by enclosing the beds by small raised ridges. This causes a crust to be formed on the beds, which is bad. A most important point is the uniform distribution of the water *over the whole surface*. Mistakes in this are liable to be overlooked in the case of *tree* plantations, as the ground is not uncovered yearly as is the case with food crops. Very frequently, owing to a faulty arrangement of the irrigation trenches or from other causes, the water is allowed to accumulate in the lower parts of the land, while the higher remain unirrigated or nearly so.

Immediately after sowing or planting the soil should be kept *moist*, not drenched, and then left to cake. The best time for *irrigating seed-beds* is the afternoon. If the soil is sandy and permeable, it will require much more water than if of a clayey nature. But very retentive soils and badly-drained soils, in which water stagnates, are not adapted for tree-growing.

Irrigation of road-side trees.

70. Nowhere is irrigation more necessary than in the case of isolated trees, and nowhere is its cost so great.

Such trees, when growing in the streets of towns and along roads, can only, as a rule, be irrigated by water brought to them by a "bhishti" or on a bullock. But, wherever possible, the irrigation should be done by trenches as this will reduce the cost very considerably.

Road-side trees should be watered about twice a week during hot dry weather, and receive from one-third to one "mashak" of water each. The "mashak," in use (away from large towns) holds about 8 gallons, weighing one maund. With the ordinary leathern bucket a coolie can *raise* to the mouth of the well, from a depth of 40 to 50 feet, about 80 of such "mashaks" full of water a day. He can distribute along both sides of a mile of planted avenue about 10 "mashaks" of water a day. Where the water lies at 10 or 12 feet from the surface, one man can raise and distribute to the trees about 30 "mashaks."

But where the distance to which the water has to be carried is more than a couple of hundred yards or so, it is much the cheaper to employ a bullock to carry the "mashak." A bullock "mashak," or "pakhál," contains about 30 gallons of water, weighing about $3\frac{1}{2}$ maunds. With this load, about 8 trips a day, or one an hour, can be made to a distance of 600 yards or so. With shallow wells of not more than 12 feet deep, about 20 "pakháls" of water can be delivered each day by this contrivance along a mile of avenue.

Precautions necessary in irrigating road-side or isolated trees.

71. In watering trees by water carried to them by a "bhishti," it is well to remember that no trees, except a few which are always found growing by water, will stand the constant application of water to their bark. Road-side trees are frequently killed by kindness of this sort. The bark is split by the sudden change of temperature, and the sap-wood rots. It is the roots that want water, not the stem. It is therefore well to heap up the earth round the stem and to hollow it out at a distance into a circular ditch, so that when the water is poured in the tree stands on a small mound surrounded by water. The crust which forms on this soil should be broken up before water is poured on it. Different contrivances have been used to economise water and secure its descent to the roots. The best is probably burying a porous earthenware "ghara" beside the roots of the tree, the mouth being closed (to prevent evaporation of water) all but where a small bamboo tube passes into the "ghara" from the surface of the soil. It is said that this contrivance answers well in districts in which there is a fair amount of natural rainfall, and that it is only necessary to fill the "gharas" with water once a month or so. But this would not be sufficient water for trees growing in very dry districts.

Where, as is generally the case, there are zamíndars' wells along a road, arrangements may sometimes be made with the owners of the wells to raise the water necessary for the irrigation of the trees at a small charge, 6 pies to 1 anna or so per tree. Such an arrangement, when it is possible to see that the trees are really watered, would cost, including the cost of the trenches leading from the wells to the trees, much less than watering by hired "bhishtís."

Seasons for irrigating.

72. It is not only useless to irrigate trees during the cold weather months—November to February—but, as the damp increases the danger from frost-bite, it is, as a rule, dangerous to do so. March to October in the driest districts, April to June and during September in the lower hills and moister north-eastern districts, are the months in which to irrigate. *Young* nursery plants require water frequently in small quantities once a day during hot weather, and, if possible, the water should be given during the afternoon. When older, trees thrive better on larger supplies at longer intervals. This causes them to send their roots to some depth into the soil, where changes of temperature do not affect them, and a more steady growth is the result. Road-side trees when established are not generally watered even in the driest districts. Many die in consequence when not near irrigated fields. But where canal water is not available and the trees have to be watered by "bhishtís," it is not practicable to water them all their life through. In such cases only the hardiest indigenous trees, such as *ber* or *jhand*, should be planted, or the trees should be planted in groves near wells.

Where trees are grown for their produce, as in fuel plantations, they must be irrigated all through their lives in the dry plains districts. Large trees grown in groves or plantations, when established, do not require more than four or five waterings in the year, and will often live even in the driest districts

on one or two waterings. Frequent small supplies of water are absorbed by the surface-soil, and much is lost by evaporation ; abundant supplies sink into the soil and remain there to be utilized by the trees. Young plants in pots require much more water and more frequent watering than when growing on the ground. Trees that are over-irrigated develop their roots near the surface only. This not only renders them liable to be blown over, but they die if the irrigation is stopped, even for a short time, as their roots cannot get any moisture.

Fencing.

Necessity for fencing in line.

73. Trees, when grown in small numbers, are so liable to be injured both by men and cattle that tree-growing on a small scale is impossible without fencing. A large proportion of the failures in road-side planting are due to the inadequate fences made for the protection of the trees planted. It is a common sight to see long avenues of trees planted and watered at very great expense, but protected only by thorn branches stuck into the ground. Trees fenced in this manner are always eaten down. The money spent on them might as well be thrown away.

A *dry thorn hedge*, formed by thorn loppings piled into the form of a hedge, is the cheapest and most commonly used fence. The bushes may be kept in position by being stuck into holes in the ground, or by being pegged down by wooden pegs cut from forked branches. With this precaution, dry loppings of *pala, phulai, jhand, kikar*, &c., form strong fences sufficient, while fresh and in order, to keep out most animals. But the thorn loppings will have to be renewed, and the hedge repaired at least once a year. These hedges are also liable to be broken down and stolen for firewood.

With the addition of a *dry ditch*, this form of fence may be made more permanent. The thorny loppings are placed on the top of the soil thrown from the ditch, and either pegged down or planted in *prepared holes*.

A *mud wall* is one of the most common and permanent of the fences used. If coped in on the top, or without this in the drier districts, the annual repairs come to very little.

A *wooden paling*, when made of a wood not eaten by white-ants, "deodár" for instance, is of course an excellent fence *while it lasts*. But, except near public buildings, where they can be well looked after, wooden palings are liable to be stolen for fuel, and they decay very rapidly if not of the best material. They are, therefore, expensive.

Wire-fencing costs for material in England from £20 to £40 per mile. It would cost, erected in the north of India, from Rs. 10 to Rs. 20 per 100 running feet mounted on iron standards and in a form in which they may be said to be capable of lasting for ever if well put up in the first instance.

This fencing can also be used when planting up *avenues of trees*. The danger is, as a rule, from the *road* side only, which can be fenced off from the trees by wire. The new form of *barbed* wire has been recommended.

Fences for isolated trees.

74. Fences used to protect isolated trees should be at least four to five feet high and enclose a circle of from five to six feet in diameter. It is almost hopeless to try to keep out camels, except by means of chaukídárs or guards. No fence that does not *admit a free circulation of the air* round the plant is suitable. A *solid* mud or brick-walling made without numerous air holes is bad.

Dry thorn-loppings piled up round the trees planted make a temporary protection, and one that is very commonly used. Such fences are, however, apt to get out of repair and are always liable to be broken down, or stolen by passers-by to light their fires. The thorn-loppings require to be constantly renewed. By the addition of a mud wall and ditch, the wall being roughly built from the soil thrown out of the ditch, the thorn-loppings may be made a real defence. The *inside* diameter of the circle enclosed by the wall should be at least five feet; the ditch to be useful should be two feet deep. But such a fence takes up too much room for anywhere but country roads.

A *wattle fence*, commonly used where branches of trees or other suitable material is available, is made by interlacing long flexible branches, basket fashion, round stout uprights embedded in the ground. Such a fence, when the material for making it is available on the spot, costs little. It has, however, all the disadvantages of other wooden fences ; it gets out of repair very quickly and has to be renewed, the material is liable to be stolen for firewood, and the fence broken down in consequence.

An open work brick-wall fence is sometimes used where bricks are cheap. This form of fencing lasts well, and admits of a free circulation of the air round the growing tree. But it is to some extent liable to be knocked down by carts or cattle, and radiates much heat.

Wooden palings are suitable for the neighbourhood of public buildings, main station roads, and so forth. When used, they should always be made of good timber that will not decay or be eaten by white-ants. The simplest form possible is the triangular shape, each bar being five feet long.

Iron guards are good in the streets of towns and station roads, where economy of space is an object. The best pattern is made of iron hoop lattice, *in two pieces*, each framed on iron bars, curved and tapered towards the top. When set up, the two pieces are fastened together with wire. This pattern of guard stands firmly, and it has the merit that it can be easily taken off a tree that has out-grown the need of it and carried off to another place ; whereas tree guards forming a complete circle are very difficult to remove from trees, and so bulky as to be inconvenient in transport.

Basket guards of somewhat the same shape are made of "pilchi" by basket-makers in Lahore and sometimes used there. They are very cheap, about 12 annas each delivered at the tree, and have been recommended for general use.

Live hedges.

Where a permanent nursery or grove of trees is required, it will often be best, where canal water is available, to fence by means of a *live hedge*. When planted along a small water-course, where they can be properly irrigated, any of the common thorny trees of the plains—*kikar*, *phulái*, &c.,—will, if properly and regularly pruned, weeded and attended to, make excellent, practically impermeable, and always ornamental fences.

The *top* of an embankment would often be the best position for a hedge, but in the plains no useful hedge plant will grow in such a dry place.

To ornament the top, different kinds of *agaves* may be used (*Agave variagata* is one of the best), or the fleshy aloe (*A. perfoliata*) may be used.

Agave fences will not require any pruning ; all that is required to keep such fences in order is to remove the numerous suckers that spring up from the roots. With these suckers, by planting them in beds for three months, other fences can be made. When the young agave plants are from 6 to 8 inches in height, and well rooted, they can be planted with the "*dibble*" in double lines or drills 9 or 10 inches apart and the plants 9 inches from each other. About 14,000 plants will be required per mile. Plants that fail will have to be renewed. The cost of planting such a hedge would be (in addition to the cost of making the ditch) about 12 annas per 100 running feet.

In order to make a hedge, a small irrigation channel about one foot deep should be dug along the line the hedge is to follow. On the earth thrown from this ditch, when flattened and pressed down, the seed should be sown or young plants planted.

In addition to the thorny trees and the agaves already mentioned, the following make good hedge plants :—

The prickly pear, grown from branches or small pieces stuck into the ground. *The lime* (sour lime) makes a highly ornamental dense hedge, always green and fragrant ; the young trees should be planted one foot apart and kept well pruned. *Sanatha* grown from seed makes a dense evergreen hedge if well pruned. *Mehndi* is also a good hedge plant, and *jaint*, grown from seed, is very fast growing ; and the small thorny *bamboo* of the lower hills can be grown as a hedge plant where well irrigated. In the hills, white thorny cratagus and different kinds of berberis, &c., form good *hedges*.

As soon as the plants in a hedge are well rooted and are in vigorous growth, they should be pruned from *below upwards* ; otherwise they will become open and irregular. Hedges may be shaped either like a wedge or cut square. In addition to pruning, *hedges should be kept clear of weeds* and rank growth underneath. Along water-courses this sort of growth is likely to become very dense, and when it is not kept down the hedge will become rugged and open.

It is well to prune *twice* a year during the cold weather, and also during the rainy season or month of August, during which time, in rainy districts or where hedges are irrigated, the growth is very rapid, and hedges if left alone become very jagged. With no hedge is this more necessary than the common *sanatha*, which with careful pruning forms a particularly dense hedge.

Various forms of Fences and Tree Guards

Section of
Dry thorn hedge with ditch

Wattle of Branches

Open work brick wall

Wooden paling: Tripod form

Mud wall with ditch - Section

Iron guard

Fence for excluding wild pig - Section

Basket work - guard

Wire fence

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MANAGEMENT OF GROVES AND AVENUES.

Thinning.

Trees after being planted should not be left to themselves.

75. Trees should not be left altogether without care after they have been planted. While young they require to be fenced, in order to prevent goats or cattle eating their branches or damaging their bark; a guardian must be employed to protect them, and in the plains they require to be irrigated. Groves of trees require while young to *be cleared* of ranker growths, where these choke the young plants. As the trees get taller, they have sometimes to be *thinned*, and road-side trees have to be *pruned*.

Thinning.

76. The number of trees on an acre of young plantation of two or three years old is often several thousand; the same plantation, when the trees have reached maturity, will probably contain not more than fifty or sixty trees on an acre. All the young trees cannot, therefore, under any circumstances, grow to full size. The operation of removing the inferior plants artificially, in order to utilize their produce and in order to leave room for the better trees to develop, is called *thinning*.

Thinning is not an *indispensable* operation, and, as a rule, where there are no valuable species to foster, it may be neglected, for, although it is one of nature's processes, more harm than good is done unless the operation is skilfully carried out. But this is because the object of the operation is not kept in view. The stems it is useful to remove by thinning are not only, as generally understood, those which are *suppressed*, but all those which crowd or injure the trees which, if left to themselves, would obviously win in the struggle for existence, or which, from their being of a more valuable kind, it is advisable to keep. Thus, if in a grove of mixed trees the least valuable kinds were dominating the more valuable trees, the former, although the largest in size, should be thinned out. Trees which give dense shade, if dominating others it is desirable to keep, must be felled. But trees of which the shade is light dominating others of a kind that can support shade may be left.

Heavy thinnings are as a rule to be avoided.

77. Care must be taken in thinning not to uncover the soil too much or too suddenly. The worst tree is useful as a cover. A too sudden and severe thinning is very bad; it exposes the trees to heat and frost, the moisture on the soil evaporates, or the ground becomes covered with weeds. While thinning sufficiently to accelerate the growth of the larger or more valuable trees left, the cover overhead should not be *entirely* broken; the branches of neighbouring trees should still touch.

Season for making thinnings.

78. The best season for making thinnings in the plains is the cold weather; in the hills, where snow lies on the ground in the winter, thinnings may be made in the early summer. If the leaves have fallen from the trees to be thinned, so much the better; it will be easier to see the trees which ought to be removed.

In a regularly-managed plantation, thinnings are carried out periodically according to the rate of growth. Thinnings may be usefully commenced as soon as the young trees obviously present an over-crowded appearance.

Pruning.

Pruning to be avoided when possible.

79. Pruning, although sometimes necessary, should be avoided when possible. The operation diminishes the leaves by which the tree lives, and causes a wound

which, though it may become covered by new wood, still remains and is often a source of decay. It is only necessary as a rule to prune road-side or avenue trees. Such trees, if not pruned, frequently assume deformed or unsuitable shapes and obstruct the roads they are planted along.

Forming straight boles in young road-side trees.

80. The smaller the branches are when pruned, the less the harm done. The natural tendency of many trees, notably the firs and pines, is to grow with a straight stem and regular conical crown. Other trees, including most of the broad-leaf trees, are most irregular in their growth, have many trunks, or great lateral branches. This, in the case of road-side trees, is inconvenient, and it is desirable to cause such trees to grow upright having one principal stem with a clean bole. By the judicious pruning, while young and small, of the lower branches, isolated trees growing along roads may be given tall, straight stems, as if they had been grown in close contact with other trees in a well-managed forest.

To obtain these conditions, the *trees should be pruned while young.* The terminal buds of any secondary leading shoots that appear should be pinched off at once; and the lowest lateral branches should be pruned off *each year* while they are *still small.* If the top is weak or broken, it may be cut off and one of the side branches allowed to take the lead.

Not more than about two rows or tiers of branches should be removed in one year. If too many of the branches are removed, the health of the tree suffers; it becomes top heavy and has to be supported. Nor ought the pruning to be commenced too soon before the tree is advanced enough to stand such treatment. The age at which pruning should be commenced and the amount to be pruned depend primarily on the rapidity and vigour of the growth. The regular stems seen in the avenues of European cities are formed by keeping the lower branches pruned while the young trees are still in the nursery. Such trees rarely require much pruning in after life.

Method of pruning large branches.

81. When very large branches *have* to be pruned off, it is advisable to first cut them off some feet from the stem and then prune the stump. In pruning, the operator makes a *small cut on the underside at the base, near the stem,* so as to prevent the branch, when nearly cut through, from falling away and tearing some of the bark off the stem below it. After the branch has been removed, any jagged ends left should be pared smooth with the pruning knife, and then the whole cut should be painted over with tar. The cut where possible should be vertical, or slant downwards, so that the rain-water may not lodge on it or get into the stem through the wound. Where the wound is necessarily large, it should always be covered with tar to protect it against moisture and decay.

Axes not to be used in pruning.

82. The pruning of road-side trees in this country is generally done by a coolie climbing the tree and hacking off the branch it is wished to remove at six inches or a foot from the stem, leaving a jagged, unsightly stump. These snags rot and bring about the quick decay of the tree. All this is avoided by using the saw instead of the axe and by cutting off the branches smoothly, *close to the stem;* such wounds soon heal and become covered with the bark. Valuable timber trees are constantly hacked to admit a free circulation of the air, as it is called, and are in consequence rendered useless, except for firewood. There are few stations or road-side avenues where such eye-sores are not to be found. *The use of the axe by coolies should be strictly prohibited.* Pruning could be done with an axe if sufficient care were taken. But this care never is taken, and the only possible way to prevent *hacking* is not to allow axes to be used.

All prunings should therefore be done with the saw or good sharp steel instruments. Small branches or twigs should be cut with a sharp pruning knife,

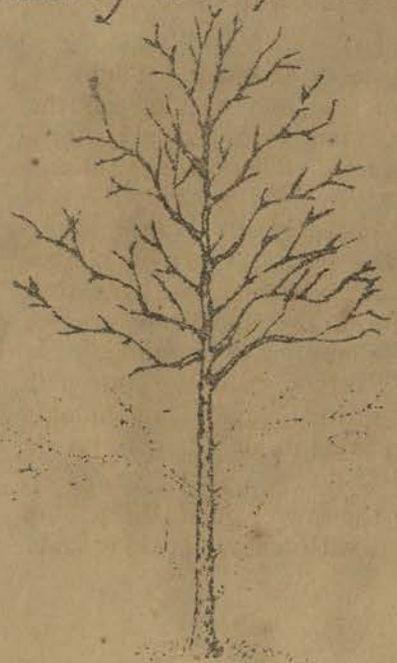
Pruning and Lopping

Pruning - European method

Pruning
Method followed in the Punjab

Pollarding - European method.

Pollarding and Lopping
Methods commonly followed in the Punjab



Training for roadside planting - Pruning.

Training for roadside planting
Removal of terminal buds.

larger branches with the saw or pruning chisel. The chisel should be used first to cut all round the branch before using the saw. In this way there will be no tearing of the bark.

The pruning of trees in groves or plantations not necessary.

83. When trees are grown together in a plantation or grove, it is not necessary to prune them at all. As already stated, pruning is an evil not to be undertaken when it can be avoided. Young trees, if grown sufficiently close together, will form straight stems by *natural pruning*, that is to say, by the dying-off of the lower branches, for want of light, while still young and small. This costs nothing, and no harm is done to the trees. Artificial pruning is always, to some extent, hurtful and costs money.

Season for pruning.

84. The end of the cold weather, just before the leaves appear, is the best season for pruning, as the wounds are then left exposed for the shortest time possible. If done during winter, they remain uncovered too long; if during the warm weather, when the trees are in full growth, the wounds *bleed*, and tar, if used, will not adhere to them.

Pollarding and lopping trees.

85. It is often useful to "*pollard*" trees. This practice is sometimes condemned, but in a dry country it is an excellent way of obtaining an annual supply of leaves for fodder from certain kinds of trees and of small branches for fuel or for basket-work. The method should not be applied to trees grown for timber. But in the case of the numerous trees of which the leaves furnish very good fodder while the wood is inferior, and in the hills, where the local supply of wood is more than sufficient while fodder is scarce, the method is to be recommended for broad-leaved trees outside the special forest areas reserved for timber growing.

Pollarding is also useful where it is wished to obtain greater shade from trees growing along a road-side. An avenue of well-pollarded trees is anything but unsightly.

Lopping, by which is meant cutting off the branches only, is also a useful method of exploiting certain classes of trees where only small branches and leaves are required. The usual way in which trees are pollarded or lopped by villagers cannot, however, be too much condemned. The method defeats its object, which is, or should be, to get as many small branches as possible. But by the rough hacking off of the larger branches, as is usually done, the vigour of the tree is so much diminished that it yields little or nothing.

Season for pollarding or lopping.

86. The proper season for pollarding or lopping is the winter, when the sap is down. If trees have to be lopped for fodder during the season of vegetation, a certain proportion of the leaves and branches should be left to perform the work for which the tree requires leaves.

Felling.

Age at which to fell.

87. The age at which trees should be felled depends chiefly on the purpose for which they are grown. In the case of groves of trees grown for ornament or shade, the best way will be to cut or remove only the dead trees and such as are blown down by the wind. Most of the former will, however, be too decayed to be useful for anything but fuel. If it is wished to obtain a yield of wood for building or for furniture, it will be necessary to *select* the older trees for felling

before they have actually decayed, and to fell a few of the oldest trees on each acre every four or five years. With small areas it will be more profitable to fell in this way at intervals of a few years than to fell every year.

Road-side and other isolated trees grown for ornament should not, as a rule, be felled until they die or are about to fall down from actual decay. No doubt they would yield better wood if felled sooner. But the cost of producing road-side trees, particularly where they require irrigation, is so great that it is far more economical to sacrifice the timber than to grow new trees.

Where plantations are formed for the production of wood, the trees must be felled at the age at which they will yield the greatest quantity of the material that is required. The age in this case also depends on the kind of tree grown and the purpose for which grown. When fuel only is required, it will be possible to fell the trees while quite young. In the plains where the ground is irrigated, it will often be possible to fell such trees at 10 or 12 years old.

But when timber for building or furniture is required, the trees must be allowed to grow to a large size. In irrigated land in the plains, this will require 25 or 30 years for even the fastest growing species. In the colder climate of the hills, it will take, according to the kind of trees, 70, 80 or 100 years to grow trees large enough to yield building timber.

"Coppice" felling.

When the trees are felled young and are of suitable species, such as sissu, kikar, farásh and all similar *broad-leaved* trees, they will, after being felled, throw out shoots from the stumps and roots left in the ground. If the stumps are cut off level with the ground, these shoots will form independent roots and grow as if they were seedling trees. A plantation can thus, by this method, be brought to give a perpetual yield without any further expenditure than the cost of protecting and, in some cases, irrigating it. Where the planted area is sufficiently large to admit of its being divided into as many compartments as there are years in the period the shoots require in order to attain the necessary size, one of these compartments may be felled each year, and the plantation will thus yield an annual supply of fuel. For instance, if a plantation was divided into 12 equal compartments, one of these might be felled every 12 years. In the 13th year the shoots or trees in the first compartment felled would be 12 years old and could again be felled, and so on.

Instances of coppice treated in the Lahore District.

This method of managing fuel plantations, which is known as the *coppice method of treatment*, has been applied to sissu plantations in the Punjab with great success, notably at Chánga Mánga and Shahdara, in the Lahore District. In these plantations, the best trees growing along roads and water-courses, and 15 selected trees per acre, are preserved to furnish timber when they have grown to a sufficiently large size. The remaining trees, when felled at the age of 16 years or so, yield, including what has been previously cut as thinnings, about 600 maunds of fuel per acre; that is to say, each acre produces about 38 maunds of fuel *each year*.

The Chánga Mánga plantation is on the borders of a canal, from which it is irrigated. Shahdara is on the banks of the Ravi, where water is near the surface; it, therefore, does not require to be irrigated. Such plantations in the Punjab, when in full bearing, would generally yield about 4 or 5 cubic feet of building timber, besides the 40 maunds of fuel *per acre every year*.

Felling trees by the selection method.

If the trees are not felled until of an advanced age, as is necessary in the case of ornamental or protective groves from which it is desired to obtain a revenue by the sale of the timber, they will have lost the power of throwing out shoots from their stumps. In such cases, and in the case of fir or pine trees, which do not coppice, no matter at what age felled, the best way will be to fell a few of the oldest and largest trees every 4 or 5 years *before the trees show signs of decay*. Or, if the plantation is large enough to be divided into compartments, *one* of the compartments may be taken in hand *each* year, and thus a perpetual *annual* yield of timber and fuel be obtained.

Grazing in groves and plantations when admissible.

There will generally be a number of self-sown seedlings in groves or woods treated in this manner, and, when they receive more light by the removal of the older trees, these seedlings will spring up and in time take the place of the trees removed. But this will not, as a rule, be the case where cattle and, more especially, goats are allowed into the woods; nor will seedlings be found where the ground is overgrown with dense jungle or "kána" grass, as frequently happens in the more open parts of old plantations in the plains. In all such cases, and wherever there are no seedlings to replace the old trees removed, young trees will have to be *planted* from time to time as the old ones are removed.

It will always, therefore, be a question, which must be decided on its merits in each case, whether or not it is worth while excluding cattle and goats in order to save the cost of planting, with its contingent charges of fencing, supervision, &c. In groves intended for the use of the public, it will generally be better to make permanent arrangements for planting* trees.

But in this case the patches where the trees are planted must be fenced in, and cattle and all other trespassers excluded from these areas.

Method of obtaining a crop of self-sown seedlings round old trees.

In some cases, particularly in the hills, it will be possible, by roughly clearing the ground and fencing in, by dry thorn loppings, small areas near old trees, to obtain patches of self-sown seedlings from the seed of the older trees. Where there is a probability of this succeeding, the older trees, which are likely to be next felled under the method of treatment here recommended, should be treated in this manner some years before the felling takes place. There will then be a crop of young trees to cover the ground when the old trees are felled, and this removal will not injure the grove. This treatment can be followed in grazed areas, provided the *patches in which seedlings are being produced are fenced in.*

Season for felling trees.

88. The best season for felling is the cold weather, when the sap is down. The wood, if it is to be used for timber, will last better; if for fuel, will contain less moisture; and if it is intended that the stumps should throw out coppice shoots, these will be more vigorous and abundant.

Method of felling.

89. Trees ought always to be felled as close to the ground as possible, or, if the trees are large, *below* the ground, as the lower part of the trunk or stem contains the most wood. When felling a large tree in the midst of others which are to remain, the branches of the tree which is to be felled should first be cut off. By this means the tree in falling will do little damage. The *very young* seedlings crushed in the removal of the trees spring up again.

Disposal of the produce of fellings.

90. When felled, if the tree is large, the branches and smaller or crooked pieces of the stem are cut into billets of equal length, which are built into stacks and sold for fuel. The trunk of the tree, or so much of it as is straight, free from large knots and generally fit for timber, is barked, often roughly squared (the white useless sap wood being cleaned off), sold as timber, either whole in the log, or sawn into planks or beams or sleepers according to the sizes and sorts in demand. Or the trees may be *sold standing*, the purchaser felling and converting the wood into whatever forms he requires.

But in whatever way sold, if the tree is large and of a kind that yields wood fit for building or furniture, there will be the two products, *timber* (in the technical sense) and *fuel.* These two products will generally have different values, and in deciding the price of standing trees the two products must be taken into account separately.

Method of getting rid of the roots in the ground.

91. Sometimes it is wished to remove a tree outright for the purpose of building a house or making a road. This, when the tree is one that throws out coppice shoots or root-suckers, as so many trees of the plains do, is very difficult, as the roots remaining in the soil send up fresh shoots. If instead of felling the tree and then stubbing out the roots, the earth is dug up and loosened about the smaller roots before the tree is felled and then the tree *pulled* over, it will act as a lever and pull out most of the roots. To prevent the broken roots that still remain in the soil sending up shoots, the chips and smaller branches should be heaped into the hole left by the root, and made into a *kiln* by being covered in with earth and set fire to when dry. This kiln, if properly made, will burn for some days, and the heat will in most cases kill most of the roots still in the ground.

THE MINOR PRODUCE OF TREES AND PLANTATIONS.

Minor produce. Importance of utilizing it.

92. The minor produce of groves and plantations and the fruits of single trees should not be neglected. Very often the cost of maintaining a planted area during the long interval between the planting and the felling of the trees will be met by the sale of the minor products, such as grass and fruits, and by the yield from the thinnings.

*Note.—It must be remembered that what is here said applies only to small areas, and not to large forests of thousands and tens of thousands of acres. It would be impossible to find labour or money to plant up such large areas.

Fruit trees, whether growing isolated or in orchards, should, when this is possible, be rented at so much per annum. It will be the best way of securing their protection.

Utilization of the grass crop. Grazing inadmissible while the trees are young.

93. In irrigated and enclosed plantations, when the trees are young, and on unplanted portions, there will generally be found an immense crop of grass. This should be cut and removed, or it should be cut and made into hay.* *Under no circumstances should grazing be allowed in a young plantation.* It is a false idea that the sum received for grazing is a source of profit in such cases. The damage done to the young trees, if it could be correctly estimated, would always be found to be greater than the amount of the grazing fees.

Besides, in nine cases out of ten, if trouble is taken and the opposition of interested persons is overcome, more money will be received for the grass when sold to cutters, or when stacked and sold as hay, than when sold for grazing; for the animals grazed trample down more than they eat.

Tools required for Arboricultural works.

English implements not often required for cultivation.

94. Various English implements are generally recommended in English books on gardening in India. But in tree-growing most of the work is done by ordinary untrained coolies, who will use nothing but the tools they are accustomed to handle. And very often it will be found that these tools are more suitable for the work to be done by the class of men available, than English implements.

Of native tools which are admirably adapted to the purposes for which they are used, may be mentioned, besides the usual and well-known agricultural instruments, the "*vahaula*," or "hoe axe," used for stubbing out roots, &c; the "kurpa," or "ramba," of universal use by coolies in nearly all gardening operations; and the grass-cutters' "daranti".

Hedge-pruning instruments of *English* make are, however, necessary. These are a hedger's bill or bill-hook, shears, and pruning knives.

In pruning and thinning, the following instruments are required:—

Sharp knives.

Indian saws (thick for green wood), with long and short handles.

Pruning chisels, with long and short handles.

Wooden mallets.

Pruning knives are made with or without a hinge.

Pruning saws ought to have very *fine teeth*, and some ought to be provided with handles of various lengths, to reach branches at different heights. The Indian saw differs from the common saw in having the teeth pointed inwards, and is thus used by being drawn towards the operator. This saw is well fitted for removing branches at a distance from the pruner. For large branches saws about 18 inches are well adapted.

The long-handled pruning chisels are used when the pruner cannot otherwise reach the branches, or finds it difficult to remove them with the saw.

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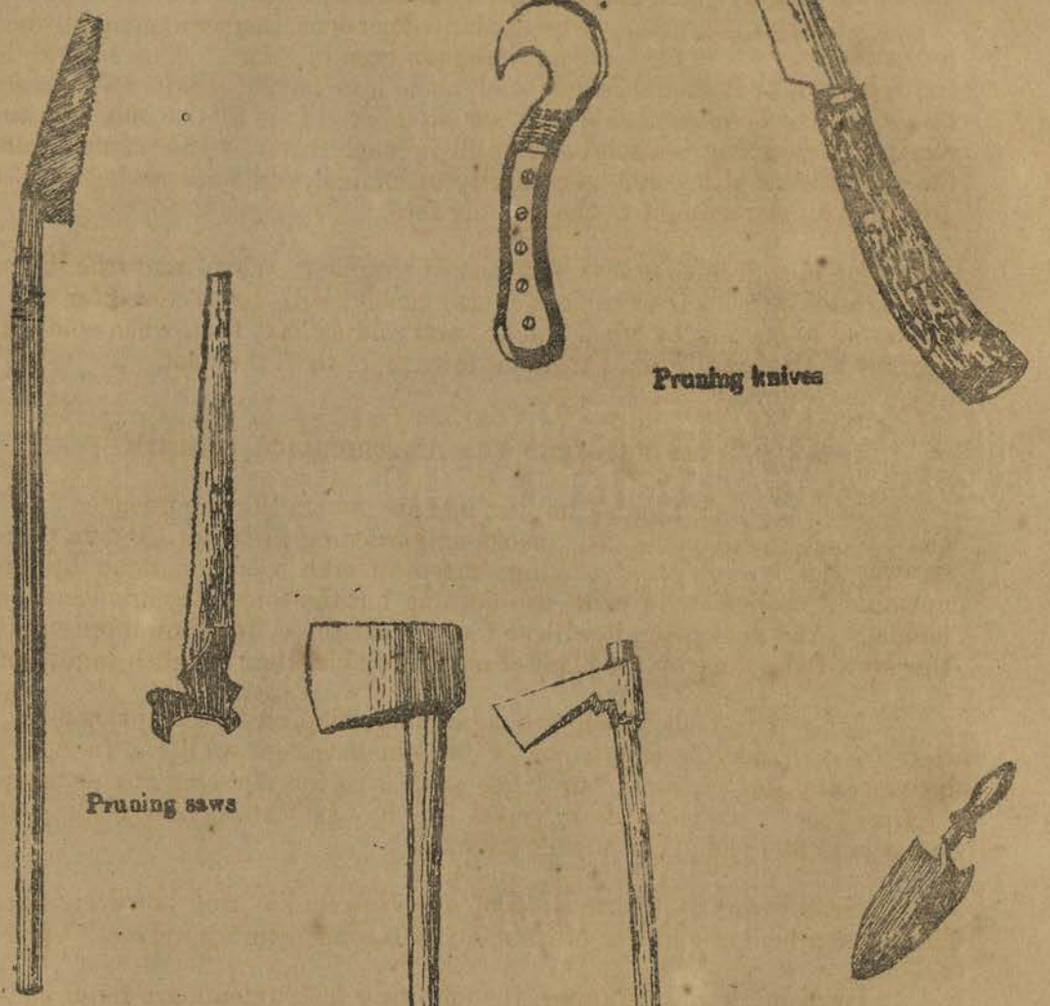
* *Note.*—The preservation of the grass crop on a plantation as hay is a very simple matter in a dry climate like that of the Punjab plains, and, in the neighbourhood of a station or town, where there is a demand for fodder, might be made exceedingly profitable. The most important rule, which, however, the natives never follow, is to cut the grass *just as it ripens*, before the seeds begin to fall or the stems to harden. Before or after this the grass contains little nourishment. Unfortunately in the plains most grasses ripen about September after the rains, when labour is difficult to obtain.

Arboricultural Tools

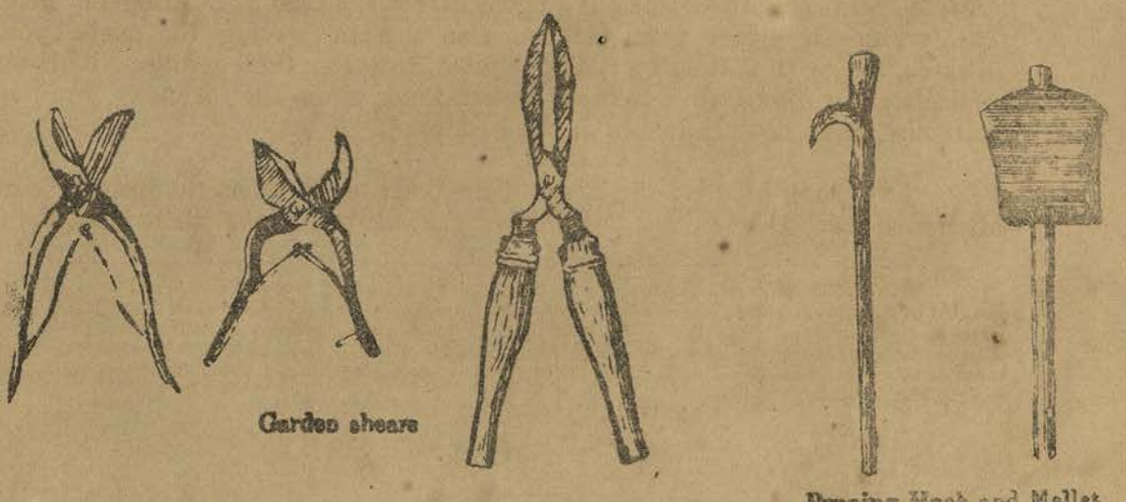


Pruning knives

Pruning saws

Axes

Garden trowel



Garden shears

Pruning Hook and Mallet

NOTES ON TREES SUITABLE FOR ARBORICULTURE IN THE PUNJAB.

The list of trees suitable for cultivation is necessarily lengthy.

95. A list which includes trees suitable for cultivation under all the circumstances and surroundings found in the vast area and widely different climates of the Punjab must necessarily be somewhat lengthy. Nor is it practicable to arrange these trees, as would at first sight appear to be most convenient in a list intended for reference, into groups and classes according to the situations in which they thrive best. It has, therefore, been sought instead to indicate the situations for which the trees are suitable.

The climate of the Punjab.

96. The Punjab, from an arboricultural point of view, may be divided into several great natural divisions, differing widely as regards climate and vegetation.

The "Hills," that is to say the higher Himalayas above 3,000 feet included in the Hill States of Simla, Kulu, Kángra, Chamba and the corner of the Salt Range in Hazára and Murree, comprise about 18 per cent. of the area of the whole Province. These regions enjoy a temperate or cold climate, a large rainfall—70 or 80 inches, and occasionally much more—contain a great variety of trees and abundant forests, and are quite distinct in all their characteristics from the rest of the Province.

The "Lower Hills" and "Siwalik Range," which skirt the base of the Himalayas to a breadth of 25 or 30 miles, include only about 5 per cent. of the whole area of the Province, but contain some of the most fertile portions of the Punjab. The rainfall is ample, 30 to 50 inches, the climate almost mild, and a very great number of different kinds of trees grow wild and are planted throughout the area.

The table-lands and low hills in the North-Western corner of the Punjab in the Pesháwar, Bannu, and Kohát Districts, and the Salt Range in the districts of Ráwalpindi and Jhelum, comprising in all about 10 per cent. of the area of the Province, present a strong contrast with the rest of the Punjab proper. The extremes of heat and cold are more marked; the cold in winter more intense; and, though the rainfall is scanty, 20 inches and less, irrigation is hardly practised. Many portions of this area are quite treeless, but in parts of the Salt Range there are several distinct kinds of trees which appear able to withstand the violent extremes of climate.

The "Plains," properly so called, which comprise 60 to 70 per cent. of the area of the Province, include climates varying from fairly moist to arid. In the *North-East* the rainfall is from 30 to 35 inches, and the facilities for irrigation are good. Almost every species of tree which thrives in the "Lower Hills" may be cultivated in this area. In the *East Central* portions of the Province, the rainfall is 25 or 30 inches, and, with the help of some irrigation during the hot weather, nearly all the "Lower Hill" trees may also be cultivated. In the remaining portions of the Punjab plains the climate is very dry or arid, and practically no trees can be grown without irrigation.

97. For arboricultural purposes, the following rough classification of districts has been adopted :—

Arid.	Very Dry.	Dry.	Fairly Moist or Forest.
Muzaffargarh.	Ferozepore.	Jhelum.	Gujrát.
Mooltan.	Pesháwar.	Gujránwála.	Gurdáspur.
Dera Gházi Khan.	Kohát.	Gurgaon.	Umballa.
Dera Ismail Khan.	Rohtak.	Amritsar.	Siálkot.
Montgomery.	Lahore.	Delhi.	Hoshiárpur.
Jhang.	Karnál.	Jullundur.	Simla.
Bannu.		Ludhiána.	Hazára.
Shahpur.		Ráwalpindi.	Kángra.
Hissar.			

HIMALAYAN SPRUCE. "TOS," "RAO" OR "RAI."

Abies Smithiana. (Wall.)

A very large evergreen coniferous tree, with a tall straight trunk.

Common throughout the hill forests, between 6,000 and 11,000 feet, associated with silver fir and other trees.

The wood is used for packing cases, planking, and indoor work; but is only durable under shelter. The bark is used for roofing huts and for water troughs.

Propagated from seed, which ripens in October to November; but, as the scales fall as soon as the seed is ripe, the ripening must be watched and the cones gathered when just about to open. If gathered at the proper time, there is no difficulty in removing the seed from the cones. The seed should be sown, when gathered, in drills 6″ apart in nurseries on northern aspects. The seedlings should be planted out when two to four years old, and shady situations should be chosen, especially if planted at low elevations. Self-sown seedlings from the forests may also be collected and planted out, as they are hardier than those of deodár; but nursery plants are preferable.

The spruce fir is a good road-side tree for high elevations.

Silver Fir. *Abies Webbiana.* (*Lindl.*) "*Pindrai*," "*Rai*" *or* "*Tos.*"—A very large evergreen tree, with dense cylindrical crown of dark green foliage.

Very common throughout the hill forests at high elevations in the same situation, but at sometimes higher elevations than the *spruce*. It is propagated in exactly the same way as the latter.

The Babul—Kikar.

Acacia Arabica. (L.)

A well-known tree, with thorny branches and small golden yellow flowers in wide spreading branches.

It is indigenous in Sind; grows well in the Punjab plains as far north as Ráwalpindi; but thrives best on a sandy loam if there is subsoil moisture. The kikar is cultivated or self-sown throughout India, save in very moist regions on the coast and in the extreme north of the Punjab, where the winter frost is too severe.

Wood, nearly colourless when fresh cut, turns red or dark reddish brown on exposure to the air; is tough and close-grained; very durable if water-seasoned; used for spokes and felloes of wheels, sugar-rollers, rice-pounders, agricultural implements, &c.; forms an excellent fuel. The bark is used for tanning and dyeing, is a powerful astringent, and in times of scarcity is ground and mixed with flour. A gum exudes from wounds in the bark, which is used in native medicines and by dyers and cloth-printers. The unripe pod is used in the preparation of ink. The trees are often lopped and mutilated for fodder for cattle.

The kikar is easily grown from seed which ripens in June-July. The seed may be sown in the rains, soon after being gathered, or it may be kept and sown in spring on irrigated land. The seed is dry, and keeps well, but it is liable to be attacked by a small weevil. Before sowing, it is well to prepare the seed by soaking it for some days in cow-dung and water; or seed which falls from the pods when eaten by goats may be collected from goat pens. The young seedlings are often killed by frost, and in the nursery should be protected during winter. This tree also grows very well when sown direct broadcast in prepared soil, especially along irrigation trenches; but it suffers much from frost, unless protected by high grass or trees or artificial sheds. In wet or inundated ground along rivers the seeds should not be sown until after the rains. When grown in a nursery for road-side planting, it should be transplanted and its long tap root pinched off.

The kikar is one of the most useful and most commonly-grown trees in the Punjab plains. It is very hardy, grows freely from seed in almost any soil, and, if near water or irrigated fields, attains a large size. It is never leafless, so that its shade, though never dense, is at all times fairly good, and its wood, bark, branches, fruit, and leaves are all useful for some purpose. The only drawback to it as a road-side tree is its thorns, which fall on the road. It sends its long tap root deep down into the soil, and makes an admirable road-side tree where the soil is too dry for the sissoo. Also where pruned, irrigated, and properly attended to, it makes an excellent hedge plant.

A variety of kikar, *Acacia cupressiformis*, is very common in parts of the Punjab; it is a tall broomlike tree, with close ascending branches, but appears to grow more slowly than the ordinary kind.

KHAIR. *Acacia Catechu.* (Willd.)—A small-sized thorny tree, common throughout India near the hills, on islands, and the banks of rivers; found in the Punjab in the outer ranges of the Himalayas up to 3,000 feet in the valleys.

The wood is extremely hard, takes a fine polish, is extremely durable and not attacked by insects. It is used for pestles, sugarcane and oil-seed crushers, wheels, ploughs, spear-shafts, &c., and is considered to yield the best charcoal for blacksmiths' work. The bark is used for tanning. The most valuable product of the tree is, however, catechu (katha), which is obtained from the heartwood by a process of boiling. This product is used in India for chewing with betel leaf, and is largely exported to Europe for dyeing and tanning.

Propagated from seed, which ripens in autumn.

A good tree for re-stocking sandy soils and "chos" along the hills.

WILAYATI KIKAR. *Acacia Farnesiana.* (Willd.)—A many-stemmed thorny shrub, with yellow, scented flowers and foliage like that of the common kikar or babúl. A native of South America, but cultivated all over India sometimes up to 5,000 feet in the Himalayas.

An ornamental shrub, suitable for gardens or groves, also as a hedge plant, for which it is very efficient. It thrives anywhere with very little water.

RERU. *Acacia leucophlœa.* (Willd.)—A very thorny tree, which grows in the plains of the Punjab from Lahore to Delhi, and in the Siwalik hills between the Jamna and the Ravi. Thrives in the more arid parts of the plains, but prefers the eastern portion of the Province.

The bark is ground and mixed with flour in times of scarcity; used in the preparation of spirits; a tough fibre is made from it for coarse cordage; wood seasons well and takes a fine polish, but is brittle and often eaten by insects; excellent fuel for locomotives. Large woody excrescences are often formed on the branches.

Propagated from seed, which ripens in April and May and retains its germinating power for years. It may be sown in any way. The best time for sowing is April or summer rains. Succeeds admirably when sown on ridges, but should be intermixed with other species. The seedlings when grown in a nursery may be transplanted during rains. Like phulai (*Acacia modesta*), reru is useful for growing in arid places and re-stocking the lower hills. Coppices well.

PHULAI.

Acacia modesta. (Wall.)

A slow-growing, thorny, moderate-sized tree, with grey foliage and white, scented flowers, which appear in the beginning of hot weather.

Indigenous in the Salt Range and low hills as far east as the Sutlej. In an uncultivated state, it prefers a rocky and arid soil, but grows well on canal embankments.

Leaves and blossoms collected for cattle fodder; wood nearly black, close-grained and heavy, is strong and durable and used for cart wheels, sugarcane-crushers, ploughs, Persian water-wheels. A tasteless gum exudes from wounds in the bark.

It is easily grown from seed, which ripens in autumn. The fruit is dry, and the germinating powers of the seed are easily preserved, but, like kikar, it is liable to be attacked by a weevil. The best time for sowing is March-April; or it may be sown direct during summer rains. The seedlings, if grown in a nursery, may be planted out during the rains.

A slow-growing tree, but one of the few kinds suitable for sowing in dry, rocky lower hills, where irrigation is impossible, and in the western plains of the Province. Coppices readily.

Maples; Mandar, Tarkan, &c. Acer sp.

There are several species of maples, all of which are very common in the hill forests, and are generally known by the same names: *Mandar, Tarkan*, &c. But the principal maples are—*Acer pentapomicum* (J. L. Stewart), *A. villosum* (Wall.), *A. caesium*, *A. caudatum* (Wall.), *A. pictum* (Thunb), *A. obliquum* (Wall.).

Acer pictum. Mandar, trekkan, &c., is the most common. It is found throughout the Himalayan forests between 4,000 and 9,000 feet.

The wood is strong and elastic, and is much used for ploughs, bedsteads, poles to carry loads, &c. The branches are lopped for fodder. The seed ripens during the summer.

A. pentapomicum is a small-sized tree, found in hot dry forests, between 3,000 to 7,000 feet, in the valleys of all the great rivers of the Punjab, except the Beas. The wood is used for ordinary domestic purposes. Fruit ripens April to June.

A. villosum is a large handsome tree, found at high elevations, 7,000 to 9,000 feet. Fruit ripens in summer.

A. caesium is also a large tree, found scattered in mixed forests in shady valleys, at from 6,000 to 10,000 feet. The wood is used for cups, platters, and various domestic purposes. The fruit ripens in October.

A. caudatum is a large tree, found only at high elevations.

All these species may be easily propagated from seed, which ripens from October to November. It should be sown in the following March, but, as it is attacked by a weevil, it should be carefully stored, mixed with bitter leaves, in bags or in "gharas" The beds should be carefully prepared and shaded during May and June. The seedlings may be planted out in shady localities during the rains when three years old.

The maples are very handsome trees, and do well as road-side trees in the hills at high elevations when planted on localities which suit them. *A. pentapomicum* grows on dry, sunny aspects ; all the other species thrive in rich forest soil ; they do best in clumps.

HIMALAYAN HORSE-CHESTNUT.—BANAKHOR—*Aesculus indica.* (Colebrook.) *Gún, kanor, &c.*—A large deciduous tree, very common in damp situations throughout the hill forests from 4,000 to 9,000 feet.

The wood is not much valued, though it is a handsome wood and takes a polish. It is used in the hills for troughs, platters, &c., and has been found to answer well for tea boxes. The twigs and leaves are largely lopped for winter fodder, and cattle and goats feed on its fruit, which in times of scarcity is eaten by the people mixed with flour.

Propagated from seed, which ripens September to October. The seed is attacked by vermin, so it should be sown at once before snow falls, or very carefully stored and sown in the spring in March or April. It should be sown in the nursery and the young trees be planted out during the rains when old enough.

The horse-chestnut will grow well in moist shady places in the dips and ravines of the higher hills, where other kinds of trees will not readily grow. The seed should be kept in moderately dry earth until sown, so as to preserve vitality. When sown, the seed requires to be protected from monkeys, &c.

AILANTHUS EXCELSA. (Roxb.)—A large deciduous tree, which grows wild in Central and South India, and is extensively planted throughout India as far north as Sahárapur. The wood is not of much use, except to make floats for fishing.

Easily propagated by seed and cuttings. The seed should be sown as soon as ripe, but it is rather difficult to get the seedlings over the first rainy season.

This is a handsome tree, not unlike túm, for which it is sometimes mistaken, but it is in leaf when the túm is not. It is a fine avenue tree for the moister districts near the hills.

An allied species, *Ailanthus glandulosa* (Desf.), indigenous in Japan, which grows very rapidly, throwing out numerous root-suckers, has been employed with success in France to clothe the sides of barren, stony hills.

SIRIN. *Albizzia Julibrissin.* (Boivin.)—A small-sized tree, with handsome red flowers and graceful foliage.

Grows wild along the lower hills, as high as 5,000 feet at times, generally on rocky, but moist ground ; cultivated in the warmer parts of Europe and in America.

The wood is beautifully mottled and good for furniture.

This is an ornamental tree suitable for gardens. There are a large number of highly ornamental trees of the *Albizzia* species cultivated in the Lahore gardens, but few are hardy. *Albizzia lucida* will not stand the cold of the plains.

Albizzia lophantha, (Benth.), a rapidly growing small tree ; recently introduced on the Nilgiris from Western Australia and now quite naturalized, has been recommended for introduction in the Punjab hills for fixing the soil. It has been tried in the Lahore gardens, but has not succeeded there. Its bark is valued for tanning, and its leaves can be used for cattle-fodder. It coppices well. This tree has been acclimatized in Italy, where it is largely grown.

SIRIS.

Albizzia Lebbek. (Benth.)

A well-known large deciduous tree, with large pods 8 to 10 inches long.

Grows wild in South India, the Satpura Range, Bengal, and near the hills to 5,000 feet as far west as the Indus; cultivated all through the Province and throughout the dry hills of India, Egypt, Afghánistán, &c.

Wood is dark reddish brown, tough, seasons well, works freely, and takes a fine polish, fairly durable, much valuable for sugarcane-crushers, oil pestles and mortars, furniture, and well-work. A mild pellucid gum exudes from cracks in the bark. The leaves and twigs are favourite fodder for camels.

It is easily propagated from seed, which ripens in September, or from cuttings. Seedlings when grown in a nursery should be planted out with earth during rains, or at the end of cold weather, if irrigated; rain transplants require an occasional watering.

One of the commonest of road-side trees in the plains. It grows fast, is very hardy, and is easily propagated. But it dies easily (at least in very dry districts), is easily uprooted, and its branches are brittle. The large pods are very unsightly, and in all but the very driest districts the handsome "*Jún Siris*" should be grown instead.

Safed or Dun Siris.

Albizzia Procera. (Benth.)

The white-stemmed siris, a tall, handsome tree, with yellowish or greenish bark.

It is not indigenous in the Punjab, but is grown there near river banks and in irrigated places. It is a native of Burma, Bengal, and the North-Western Provinces near the hills.

The wood is straight and close-grained, seasons well and is durable. Used for sugarcane-crushers, rice-pounders, agricultural implements, wheels, &c. In times of scarcity the bark, mixed with flour, has been used as food. Bark also used for tanning.

It is propagated from seed, and also readily from cuttings. The seed ripens in April, and should be sown at once in watered nursery beds, or on ridges during the rains. The seedlings should be planted out, with the earth round the roots, during the rains or towards the end of the cold weather. Cold weather transplants to be watered until rains begin: rain transplants require an occasional watering until October.

This is an excellent tree for district arboriculture, and should always be preferred to the common siris *where it can be well irrigated.*

Ohi. *Albizzia Stipulata.* (Boivin.)—A large handsome tree, with graceful, bright green, feathery leaves, abundant in the Kángra valley in the Punjab.

The wood is not much valued. The branches are lopped for fodder. It is propagated from seed, which ripens in autumn. Seedlings when grown in nursery should be planted out during rains, or at end of cold weather if irrigated. Winter transplants should be watered until the rains begin; rain transplants require an occasional watering till October.

This tree is a good tree for planting in the districts underlying the hills. Elsewhere it appears to suffer from the great changes of temperature.

Bengal Quince.—Bel. *Aegle Marmelos.* (Correa.)—A small hardy tree, with very beautiful foliage: wild in Siwalik tract and outer hills to 4,000 feet.

May easily be grown from seed in any deep soil, if irrigated. The large fruit is used medicinally, and the pulp makes a pleasant sherbet.

Candle Nut Tree. *Aleurites Malacana.*—An evergreen tree, with very glossy foliage.

A native of South America.

Wood soft: from the fruit, fat is pressed and sent to the European market.

Propagated from seed, which ripens about July to September. The seed should be sown at once, either in open ground or singly in 6-inch pots (seeds are very large). The seedlings should be planted out when two years old.

This tree is cultivated in the Agri-Horticultural Gardens, Lahore, and might be tried in other places in the plains.

ALDER.—PIAK. *Alnus nitida.* (Fndl.)—A large handsome tree, common in the hills to 9,00 0 feet and along the banks of main rivers, Jhelum and Chenab, some distance into the plains.

The wood is used for furniture and for fuel. The twigs are tough, used for tying and in construction of twig bridges in the hills. Bark is used for dyeing and tanning. Leaves are sometimes used for fodder.

It is propagated from seed, which ripens from November to December, and from cuttings or from self-sown seedlings, which are easily obtainable in the forest. These should be planted in moist places. The seed should be sown at end of cold weather in moist shady beds near water, and the seedlings planted out when two or three years old. Cuttings should be made in June or July, and put out in sandy moist beds until they have taken root. They can be planted out before snowfall in December or during following rains.

This is a very good road-side tree for moist sandy situations at high elevations.

ANDRACHNE TRIFOLIATA (Roxb.), OR *Bischoffia Javanica.* (Blume.)—A handsome, evergreen spreading tree.

It is easily propagated from seed, which ripens in November-December. The seed should be sown early in March in prepared beds or pots, and the seedlings be planted out when one-and-half to two years old. The young plants should be slightly protected from frost. The seed can be obtained from Royal Botanical Gardens, Calcutta, and also from Saháranpur.

Cultivated in the Agri-Horticultural Gardens, Lahore, and might be tried in other moist or well-irrigated places in the plains.

CUSTARD-APPLE.—SHARIFA. *Anona squamosa.* (Linn.)—A shrub or small tree, a native of the West Indies, but almost wild in the Central Provinces, and commonly domesticated over a great part of India; and cultivated for its well-known delicious fruit as far north as Gurdáspur in the Punjab. It is grown at Delhi from seed. Fresh seed should be sown in a deep stony soil very well manured and irrigated.

The custard-apple is not, however, suited for growing in the drier districts, even in irrigated gardens. It cannot stand frost. May be grown in east parts of the Province about Delhi.

KAMRAKH. *Averrhoa Carambola.* (Linn.)—A small tree of unknown origin, cultivated for its fruit throughout India as far north as Lahore, and is said to succeed well at Hoshiárpur and Delhi. It is grown from seed, which ripens in the cold weather. The fruit is intensely acid, and is used for pickling and stewing with sugar by the natives.

Does not thrive in the drier districts.

BAMBOO—BANS.

Bambusa arundinacea. (Retz.)

A large feathery bamboo, a native of southern India; cultivated along the outer hills, at Dehra Dún, in the Kángra and other districts, to 4,000 feet and over.

This bamboo is used for a variety of well-known purposes. It is large enough to furnish poles for carrying.

It is propagated from seed, when procurable, and from offsets. The seed should be sown in pots in March and watered regularly: may be planted out in pits in a good, rich, and moist soil. The whole clump that has come up in the pot should be planted into the pit, without disturbing the earth round the roots. This can be done by breaking the pot. If seed be not procurable, an already existing clump should be cut down about 3 feet from the ground, the stumps or offsets dug out and planted separately in manured soil; they will require regular watering at first.

A few clumps of bamboo planted in a nursery where they can be irrigated will be found exceedingly useful for an endless variety of purposes connected with nursery work; making shades over seed-beds and young plants, fencing, and so forth.

Cultivated in the lower hills, and may also be grown in gardens in the plains.

MOHWA. *Bassia latifolia.* (Roxb.)—A well-known large tree, cultivated and self-propagated throughout India.

In the Punjab it grows in the lower hills and outer valleys of the Himalayas as far as the plains.

The wood seasons well ; is strong, tough, and durable. The tree is cultivated for its flowers, ich are dried and sold as an article of food. They are eaten both raw and cooked, put in sweetmeats, d spirit is distilled from them.

It is propagated from seed, which ripens from June to July. The seed should be soaked in wate or twelve days before sowing. Self-sown seedlings are generally to be found near old trees when ced in. These may be collected and reared in the nursery until fit to plant out.

This tree blooms, but does not produce seed in Lahore or districts of similar climate.

KACHNAR. *Bauhinia variegata.* (L.)—A well-known, moderate sized, deciduous tree, with lobed ves.

Grows wild in most wooded parts of India; is common in the Salt Range and in the outer hills the Punjab up to 4,000 or 5,000 feet.

The wood is used for agricultural implements ; the leaves and flower-buds are eaten.

It is easily grown from seed, which ripens in June or July. The seed should be sown in nursery eds, or pots with prepared soil, and be well watered. The seedlings require much light, and will not spring up in shade. They should be planted out during the rains.

Cultivated throughout India for the beauty of its flowers.

Another species, *Bauhinia alba*, has beautiful white flowers and is grown in the same way. *Bauhinia acuminata* has graceful pendulous branches and large whitish or pink flowers.

HIMALAYAN BIRCH.—BHURJ. *Betula Bhojpattra.* (Wall.)—A very handsome deciduous tree, found at the extreme upper limit of forest vegetation, from 10,000 to 12,000 feet and even higher. The wood is hard, but is not of much value, though it is used. The bark called "toz," "bhojpattar" in Kashmir, "bhurj" and "drawa" on the Chenab, resembles paper and readily peels off. It is very lasting, and is used as paper for writing and packing, umbrella covers, to line the inside of "hukah" tubes, and in the construction of houses. It is also used by Hindús in various religious ceremonies, and is largely exported to the plains for packing and other purposes.

This tree would grow well if cultivated at the elevation of most hill stations, and would be a very beautiful addition to groves.

COTTON TREE—SIMBAL OR SIMAL.

Bombax malabaricum. (DC.)

A large deciduous tree, with horizontal branches and large crown.

Grows wild throughout India, except in the more arid climates, and is very generally cultivated.

The wood is coarse-grained and porous, used for planks, packing cases, toys, scabbards, and for lining wells. A gum exudes from the wounds in the bark which is employed in native medicines. A portion of the flower-bud is eaten as a vegetable. The handsome flowers appear in February to March, and the seed-pod contains a fine silky fibre useful for pillows.

Propagated from seed and also from cuttings. The seed ripens in April to May, and may be sown at once in the nursery. It will easily succeed if the beds are slightly watered until the rains. It will also grow freely from cuttings, which may be set direct if they can be freely watered, or small cuttings may be set in the nursery beds until rooted and planted out during the rains.

Near the hills, or where sufficiently irrigated, this tree will grow very fast. It requires a loose sandy soil; on a clayey soil it sends out ungainly adventitious branches. It is rather a formal tree, but is useful to mix with others. Its shade is fairly good. Its pods when they fall are a nuisance near a dwelling-house for a few weeks.

THE PAPER-MULBERRY. *Broussonetia papyrifera.* (Vent.)—A small tree like the fig in appearance. A native of Japan and China. Has been introduced into Europe and other countries, and thrives well. The strong fibrous bark is used in China for paper and similar purposes.

Propagated from cuttings set in February.

This tree has been recommended for cultivation in North-Western India by Brandis. It is grown in the Agri-Horticultural Gardens at Lahore.

Chichhra, or Dhak.

Butea frondosa. (Roxb.)

A moderate-sized tree, with a crooked trunk and few branches; has very handsome flame coloured flowers, in brown velvety cups, which appear in March-April. It grows wild throughout India as far west as the Jhelum ascending to 3,000 feet; thrives on the saline soils of the Punjab, along the hills, but is rare to the south of Lahore, although sometimes planted in southern districts.

The wood is not strong or durable. It is sometimes used for well-curbs and for charcoal and fuel. The leaves are much used for fodder, for plates and wrappers, and the trees are generally found more or less lopped and hacked. A dye is extracted from the flowers.

It is easily grown from seed, which ripens June to July. The seedlings are very hardy and require no special precaution.

This tree is chiefly valuable for the beauty of the flowers. But its hardiness recommends it. It may be grown anywhere, except in the more arid districts to the south of the Province.

Papaya—Arand kharbuza.

Carica Papaya. (L.)

A very handsome, but small, soft-wooded and short-lived tree; a native of Brazil. Cultivated throughout India as far north as Saháranpur and Delhi.

It is very easily grown from seed, which should be sown during the rains and planted out. The fruit is sweet and pleasant, and the unripe fruit is excellent cooked as a vegetable. This tree bears fruit very young, 18 months after sowing. It may be grown in any well-regulated garden or orchard in the east of the Province. The fruit is borne on the "female" stems only. These may be distinguished by the larger size of the flowers. One "male" or non-fruit-bearing stem should be planted with each group of "female" flowers.

Karaunda. *Carissa Carandas.* (L.)—A large evergreen shrub, cultivated in most parts of India, but not much in the Punjab. It is wild on dry, sandy, and rocky hills in the Oudh forests.

The wood is hard and excellent for fuel. It is also a good hedge-plant. The fruit is largely eaten and is sold in the bazárs.

It is propagated from seed, which ripens in July to August.

Might be cultivated in the eastern parts of the Punjab.

The Indian Laburnum—Amaltas. *Cassia Fistula.* (L.)—A moderate-sized well-known deciduous tree, with yellow blossoms which appear in May. Common throughout the forests of India, and grows wild in the lower hills of the Punjab Himalayas to 4,000 feet, and commonly planted in irrigated gardens in the plains.

The wood is used for posts, carts, implements, rice-pounders, but large wood is rare; bark is used for tanning and dyeing. The fruit, black when ripe, contains a pulp between the seeds which is used as a purgative.

It is propagated from the seed, but this germinates badly. The seed ripens in the cold season, and should be prepared for germination by keeping in a pot buried in a moist dung-pit for some months. Seed should be sown at the beginning of the rains in prepared nursery beds, or in pots with prepared soil, and the seedlings planted out during the following rains or two years later.

This tree is recommended for groves in the plains, chiefly for the beauty of its flowers, but *not* as a road-side tree, as its shade is not very good and it is leafless during a part of the year.

There are a number of other species of *cassias*, mostly small shrubs, but with pretty feathery leaves and generally handsome clusters of flowers. They are reproduced from seed, but are mostly a little shy of germination.

The *English* Laburnum (*Cytisus laburnum*) can be easily grown in the hills.

Spanish Chestnut.

Castanea vulgaris. (Lam.)

A large tree, which attains an enormous age and gigantic dimensions in Southern Europe, where it is indigenous. Has been introduced into India, and grows well throughout the North-West Himalayas at from 4,000 to 6,000 feet. It is being cultivated in Kulu and Bashahr.

The wood is dark brown and very durable, and is highly esteemed for building and nearly all purposes for which oak is used in Europe. The most valuable product of the tree is, however, its fruit, which forms an important article of food for the inhabitants of Central France and other countries.

It is propagated from seed, which ripens from August to September, and may be sown when gathered or kept until the following spring in March or April. The seed should be carefully protected from the attacks of vermin, &c., and must be kept in moderately dry earth until sown, so as to preserve its vitality. The seed should be sown in drills, 6 to 12 inches apart, in prepared nursery beds in rich soil, and covered with fine soil or leaf mould to hide it from birds, monkeys, &c. The nursery should be well fenced, and thorny branches put over beds. A surer way is to sow the seed in prepared soil in boxes or pots out of reach of vermin or birds, and when the seed has germinated to prick out the young seedlings in nursery beds. Seedlings may be planted out during the winter when three or four years old.

This is a hardy tree and grows well, especially on limestone soil. It has not yet been tried to any extent in avenues or in groves in India, but would probably succeed well at suitable elevations. Some of the trees grown in India appear inclined to grow "short" and bushy: in groves it should be planted close.

Beefwood Tree. *Casuarina equisitefolia.* (Forster.)—The well-known large Australian *beefwood tree* grows wild on the wastes of Chittagong and Burma and in North Australia; cultivated throughout India.

The wood polishes well, but cracks and warps; yields excellent fuel.

It can easily be grown from imported or acclimatised seed gathered from trees planted in India. Several other species of Casuarina are also grown in this country—*C. muricata, C. quadrivalvis, &c.*

As this tree is leafless, it should only be grown as a curiosity, or, where it thrives, for fuel. It is said to grow well at Umballa, and does fairly well in the Lahore gardens. Large plantations of it have been made near Madras for fuel, and have succeeded admirably, the yield of fuel being enormous. The chief requirement of the tree is a sufficiency of water. It might perhaps succeed on "sailába" land along a river, where the water was never very far from the surface. As its shade is so light, other slower growing species might be grown underneath it. It might prove very useful as a nurse over more delicate plants to keep off both sun and frost.

Catalpa Syringifolia.—A large-leaved tree, with fine, whitish, scented flowers. It is propagated from seed and from cuttings; seed ripens in September, and should be sown in pots or boxes with prepared soil the following March. Cuttings made during the rains are said to succeed best in the hills. It is useful as an ornamental tree. Grows freely at Lahore.

Darawi. *Cedrela Serrata.* (Royle.)—A tall handsome tree, very like "tun" in appearance; grows wild in the valleys of the Himalayas extending on the Indus as high as 8,000 feet in moist shady places.

The wood has a strong smell, something like that of the *pencil cedar,* and is used for furniture; leaves for fodder.

It is propagated from seed, which ripens in August, and should be sown when gathered, and the seedlings transplanted during the rains.

Suitable for cultivation in moist shady places in the hills.

Tun.

Cedrela Tuna. (Roxb.)

A tall and remarkably handsome tree, with beautiful dark green leaves.

Indigenous in the lower hills of the Punjab up to 3,000 feet, and cultivated throughout India; requires a rich soil, but will grow on any inferior

soil if kept moist enough; very liable to the attacks of an insect which consumes the pith of the young shoots, but the tree is not as a rule killed by it.

The wood is red, not strong, but seasons readily, is easily worked and polishes well, is highly valued as a furniture wood and for door-panels and carving. In some parts of the hills, the leaves and young shoots are lopped as cattle-fodder. The bark is a powerful astringent, and from the flowers a yellowish dye is made. The tree is evergreen or nearly so.

It is propagated from seed, which ripens in June. The seed should be sown as soon as collected, as it is very difficult to keep. The nurseries should be shaded, as the young seedlings are very delicate for the first year or two, and suffer both from sun and frost. Nurseries under trees, or between rather open lines of sissu, kikar, or mulberry, do well, or the seed may be sown in pots. The soil should be rich, and must be well worked and cleared of roots. Seed may be sown broadcast, or better on ridges on account of watering; must be covered lightly. The young seedlings want protection against direct rays of the sun in summer and against frost in winter. The young seedlings may be planted out in March or during the rains. For avenues, plants not less than two years old should be used. They will require a good deal of watering at first.

This is a valuable tree for planting on road-sides, round wells, and within villages, but it is not to be recommended for planting along fields, as, owing to its dense shade, it injures the crops.

Himalayan Cedar—Diar.

Cedrus Deodara. (Loud.)

The well-known, large, handsome, dark-green *cedar tree* of the hills, common throughout the hill forests from 4,000 or 5,000 feet to 9,000 feet; shuns the southern slopes of the hills and badly drained, moist soils or damp localities. Does not require a deep soil.

The wood has a fine light-brown colour, is fragrant and somewhat oily and compact; does not readily warp or split and is very durable; it is the most prized wood in the Punjab for all kinds of construction.

It is propagated from seed, which ripens about October at the end of the autumn, and must be gathered at once just as it ripens, before the scales open and the seed falls. To extract the seed, the cones are dried in the sun until the scales open or until they do so under a little threshing and manipulation with the hand. The seed should be sown in November as soon as ready. This is much safer than keeping it over until the spring, as it is liable to be attacked by insects. Seed should be sown in well-prepared nursery beds, in drills nine to twelve inches apart. The nursery plants are hardier, and to be preferred to the natural-grown seedlings. The seed will germinate early in the following spring, and should be protected by light shades from hail and from the sun until the rains. Watering is not necessary as a rule, but a little may be given in May and June in dry places away from the forest. Once the rains have arrived, no other care need be given to the seedlings, except a slight weeding and perhaps shading from the frost during the winter until the next year, when, if not planted out in groves the first year, they should be transplanted in the nursery to prepare them for road-side planting, when tall and strong enough to take care of themselves about the third year. The greatest care must be taken not to injure the tips of the tender roots. For this it is best to transplant with earth round the roots: transplanting or planting out should be done during the rains.

A handsome tree for road-sides or for groves in the hills, particularly steep slopes and west aspects; young trees may be planted out four feet apart in lines when fifteen months old and nine inches high. Road-side trees should be three times this size.

KHARK. *Celtis Australis.* (L.)—A middle-sized tree, grows wild in Afghánistán, the Salt Range, and in the hills to 8,000 feet; is frequently planted in the Punjab, in Sind, and Bilúchistán for shade and fodder.

The wood is used for churn sticks in the Himalayas, and for fuel and charcoal. The leaves are used for fodder, and the fruit is eaten by the natives and is used as a medicine.

It is propagated from seed, which ripens in September. The seed should be sown in March, in prepared nursery beds in drills six inches apart and lightly covered with earth. The seedlings may be planted out during the rains when tall enough.

This tree grows on rich moist soil. It is a good avenue tree for dry sunny situations.

CAROB. *Ceratonia Siliqua.* (L.)—A slow-growing evergreen tree of small size, indigenous in Spain, Algeria, Egypt, Syria and the East Mediterranean region, where its pods, which contain a nutritious mealy pulp, are a common article of food for man and beast.

The tree when planted grows easily in irrigated land in the Punjab, but the pods do not appear to contain much nutritious matter, and are seldom eaten by cattle.

It is propagated from seed, or from grafting, or from cuttings. Seed can be procured from the Agri-Horticultural Society's Gardens at Lahore, or the "Carob Plot" under the Forest Department. The seed should be sown in nursery beds, or in pots with prepared soil; latter preferred. Seeds should be sown in February; cuttings should be made in spring. Seed sown in pots filled with fresh horse-dung and some earth germinates readily. The seedlings should be transplanted into other pots before the cotyledons drop off. Seedlings require protection from heavy rains and from the sun; they should be planted out during spring or rains, and should be watered during the hot weather.

This tree grows well under shade of other trees. Fairly established and with male and female plants more equally distributed, it would probably yield an abundant fodder crop.

ORANGE—SANTRA—NARANGI.

Citrus Aurantium. (L.)

The *citrus* or orange family, which includes the orange, lemon, citron, sour and sweet lime of the gardens, are small shrubs found in a wild state in several localities in India in the hills, at various low elevations from 1,000 to 4,000 feet. They are cultivated all over India for their fruits.

Oranges succeed admirably in the dry parts of India, and grafted varieties of superior kinds are largely grown at Gujránwála and elsewhere in the Punjab. There are several kinds, all of which can be reproduced by budding them on stocks of sweet lime. These stocks can be easily raised by sowing the seed of a well ripened lime, or better by planting cuttings of sweet lime. The seed of the lime should be sown in a heavily manured nursery bed, in lines six inches to one foot apart, after being transplanted to one foot apart. When the young plants are three feet high, they may be "budded" with any variety of orange it is wished to reproduce. These young grafts should be planted out in a nursery or orange grove in lines 10 feet apart, and kept well manured, cultivated and irrigated until they bear fruit, which will generally be in about five years if properly attended to. To save expense, gardeners generally grow crops between the orange trees, and this is an excellent plan. Lucerne or good "dúb" grass might, too, be grown, and would yield a large crop of grass several times a year. The trees will require careful watering and cultivation. Any shoots that spring up from the stocks will have to be pruned off. Valuable orange groves can be prepared in the above way at very

little expense, by utilising the land between the trees to grow crops on. With plenty of manuring and irrigating, the crop will be a good one. The other species of *citrus* common in the plains are—

Sweet lime	...	Mitha	... *Citrus Limetta.*
Lemon	...	Khatta	... *Citrus Medica.*
Pumelo or Shaddock		Chákotra	... *Citrus Decumana.*
Sour lime, citron	...	Nimbu	... *Citrus Acida.*

They are all cultivated in much the same way as the orange. The pumelo is a beautiful tree worth cultivating apart from the value of its fruit, but it thrives best in a moist hot climate, though grown about Delhi and even at Lahore. Oranges are best grafted on the *sweet lime*, and lemon and pumelo on the *sour lime*. They all require to be well manured and watered. *Malta* oranges grafted on the lime have succeeded admirably at Gujránwála.

Lasura.

Cordia Myxa. (L.)

A moderate-sized tree, 30 to 40 feet, with a short trunk and a rounded crown; foliage dense, light green; small white flowers in clusters. It grows wild in the Punjab Salt Range and in the Sewalik tract up to the Ravi, and is commonly planted in the plains and on the hills up to 3,500 or 4,000 feet, and cultivated throughout India. The fruit is eaten as vegetable or pickled. It is also given for coughs, &c., and in Sind also fuse is prepared from the bark of this tree. The kernel is also eaten.

It is propagated from seed, which ripens in May and June. The seed should be sown when gathered, and the seedlings planted out during the rains.

This is not a very good avenue tree, as it is rather irregular in its growth. It gives fairly dense shade. Suitable for cultivation in the plains and lower hills.

Haleo. *Cornus macrophylla.* (Wall.)—A handsome middle-sized tree, common in the hills up to 6,000 or 7,000 feet.

The wood is noted as yielding excellent charcoal for gunpowder. The fruit is eaten, and the leaves furnish fodder for goats.

It may be propagated by cuttings or root-suckers, or may be grown from seed, which ripens in October to November. Cuttings or root-suckers, put out at the beginning of the rains in fairly moist beds, set rapidly. Large cuttings set direct also succeed. If wanted for dry localities, the cuttings should be set in nurseries for a year and transplanted in the following rains when well rooted.

This is a good hardy avenue tree, and will grow in either dry or moist situations at high elevations.

Hazel. *Corylus Colurna.* (L.)—A small or moderate-sized tree, common, wild throughout the hill forests from 6,000 to 10,000 feet, often forming extensive thickets. The wood is considered a good timber. The nuts are quite as good as the English hazel nuts and are eaten in the hills.

It is propagated from seed, which ripens in July and August, and remains one year in ground before germinating.

Suitable for cultivation in moist places at high elevations.

Hawthorn. *Crataegus Oxyacantha.* (L.)—A small tree, with well-known handsome flowers sometimes cultivated near villages, and growing wild throughout the hills from 6,500 to 8,000 feet. Its wood has no special uses. It is cultivated on account of its flowers and the edible fruit, which is much better and larger than that of the European hawthorn.

It is propagated from seed, which ripens from September to October, and should be sown when ripe. This tree is highly ornamental when in flower, and Natives in the hills appreciate the fruit.

BARNA, BARNAHI. *Cratæva religiosa.* (L.)—A handsome tree of moderate size and striking appearance, with a luxuriant flush of pretty cream-white flowers in spring; common, growing wild in low and shady places near banks of rivers in the lower hills as far west as the Ravi up to an elevation of 2,000 feet, and cultivated throughout India, in the Punjab as far west as the Jhelum.

The wood is easy to work, fairly tough and durable and not heavy; used for drums, models, writing-boards, camp-boxes, and in turnery. In the Punjab the viscid pulp of the fruit is mixed with mortar as a cement, and as a mordant in dyeing.

It is propagated from seed, and is a handsome tree for planting near wells and in moist places in the plains.

TWISTED CYPRESS. *Cupressus torulosa.* (Don.)—A large tree found between 6,000 and 8,000 feet in the outer ranges of the hills, but more local and less common than most other Himalayan conifers. The wood is fragrant, and is frequently used in the Punjab hills for incense in the temples and for carving images. Elsewhere it has been found excellent for building in indoor work.

It is propagated from seed, which ripens in October to November, and is long persistent on the tree. The seed should be sown in boxes in prepared soil, and the seedlings may be put out when four years old. This tree has been planted in several places even in the plains. It is useful as an ornamental tree on account of its foliage.

There are a great number of other species of cypress, *viz.*, *C. funebris* (Endl.); *C. horizontalis*; *C sempervirens* (Linn.); *C. glauca* (Lam.), which are commonly cultivated in gardens. All may be grown in the hills wherever the *C. torulosa* will thrive. *C. sempervirens*, known as sarú, is common in most of the station gardens in the Punjab plains and in Kashmir, &c. Seedlings may be obtained at the Lahore gardens.

SHISHAM.

Dalbergia Sissoo. (Roxb.)

A handsome tree, very commonly planted as a road-side tree throughout the Province. It has large branches supporting a spreading crown. It grows wild along the hills from the Indus to the Brahmapútra, ascending to 3,000 feet and over. It prefers a moist climate in the immediate vicinity of the great rivers, where it grows spontaneously. Has a preference for light, sandy soils. Very stiff soils do not suit it. It requires much room and light to grow. Grows rapidly and can resist frost, which, though it turns the leaves black, does not kill the plants; is the most important tree in the fuel plantations made in the Punjab plains.

It is propagated by seed or by cuttings. Seed ripens in December and January, and may be sown direct or in a nursery and the seedlings planted out. On irrigated land sown along the trenches it succeeds admirably, or on sailába land it may be sown broadcast after the land has been ploughed up. Sowings should be made at the beginning of the hot weather in irrigated land, and during the winter rains on sailába, or, if the ground is liable to be flooded, after the rains. Where no irrigation is required, sowings should be made during the rains. Transplants may be made with or without earth. They are benefited by a watering at time of transplanting. For road-side planting, seedlings should be watered twice a week until rains set in.

A similar kind, the Bombay "blackwood" (*Dalbergia latifolia*), is a handsome tree, which grows well in the Punjab and can be raised either from seed or cuttings. As a shade-giving tree, it is, however, inferior to the common sissu. Both as a shade-giver and as a timber and fuel tree, the sissu is excellent, and, as it is very hardy, it is a useful tree for district arboriculture.

Male Bamboo—Bans.

Dendrocalmus strictus. (Necs.)

A small thorny bamboo, with nearly solid stems, common wild throughout India wherever there is sufficient rainfall. In the Punjab it is found wild only in a few places in the outer Himalayan hills, ascending to 3,000 feet, and to a small extent on the east side of the Salt Range. It is gregarious, forming patches of forest in the hot, dry, stony hills on the banks of the Beas and Chenab and west of the Jhelum, north of Ráwalpindi.

The stems are much valued for roofing, wattling, basket-work, &c., and the leaves are used as fodder.

It is propagated in the same way as described for the bamboo of the Kángra District; grows well in clumps, and may also be grown as a hedge.

Suitable for cultivation in irrigated gardens in the plains.

Dillenia indica. (L.)—A small, but handsome, evergreen tree, with a short, erect, bulky trunk and leaves in large tufts. Grows wild along the base of the Himalayas from Nepal to Assam and in the south of India, and is cultivated all over India. The wood is made into gun-stocks, and sometimes used in construction. The rough old leaves are used as polishers, and the young leaves are used as food. The tree is grown from seed, which ripens in February. May be grown in the lower hills; will not stand the frost in the plains.

Kendu. *Diospyros montana.* (Roxb.)—A handsome moderate-sized tree, common in most parts of India, except in Sind and the Northern Punjab; grows wild in the plains along the base of the hills as far west as the Ravi. The wood makes a beautiful furniture wood. In November this tree is laden with yellow fruit resembling oranges, but which, however, are very bitter and not edible.

The tree is grown from seed, which ripens during the early winter months.

Suitable for cultivation in the districts underlying the hills as far as Ravi.

Tendu. *Diospyros melanoxylon.* (Roxb.)—A middle-sized tree, found growing wild along the base of the hills as far west as the Ravi. The wood is reddish, tough, and fairly durable; used for buildings and for shafts of carriages. The wood in the centre of old trees is generally jet black, like ebony, in an irregularly shaped form.

It is grown from seed, which ripens in March-April.

Suitable for cultivation in the same localities as "Kendu."

Amlok. *Diospyros lotus.* (L).—A moderate-sized tree, which grows wild in the hills along the Jhelum and Kashmir between 2,500 and 6,000 feet; and in many other places, and very abundant in Afghánistán and Bilúchistán. The fruit is sweetish and much prized by the Afghán tribes.

The tree is propagated from seed, which ripens in June to August.

Suitable for cultivation in the lower hills.

The Loquat.

Eriobotrya Japonica. (L.)

A well-known fruit tree, a native of Japan and China, but cultivated in Bengal, South India, North-Western Provinces, and Punjab. Thrives well in the latter place, and, when cultivated is excellent, and is much esteemed by the native population. The common sorts are grown from seed, but the fruits have very little pulp in them. They should be used merely as stocks on which to graft a select variety.

Suitable for cultivation in the plains and lower hills.

The Indian Coral Tree. *Erythrina indica.* (Lam.)—A well-known moderate-sized tree, with bright scarlet flowers, which appear in March before the leaves. Grows wild in Bengal and Burma, and planted throughout India. The wood is much used for making light boxes, toys, &c. Does not warp or split, and varnishes well. Most lacquer work boxes are made of it.

Grows readily from cuttings.

This is a very fast-growing tree in a damp climate or where there is water, but as it is leafless for a long time, and its shade at all times is poor, it is not suitable for road-side planting. It might be put out in groves in the moister districts, along the lower hills, for the beauty of its flowers.

Australian Gum-trees.

Eucalyptus sp.

Numerous species of these have been introduced into India, and grow with great rapidity. The wood is very much esteemed in Australia. A great number of species will thrive in the hills at various elevations. Of these—

Eucalyptus globulus, E. leucoxylon, E. siderophloia (which succeed so well at Abbott-abad); *E. colossea, E. gigantica, E. Stuartiana, E. longifolia*, and a great many others, are well known.

E. globulus, the "blue gum," is the most commonly cultivated in the hills, but will not grow in the plains. It grows rapidly in good moist soil. The seed should be sown in shaded nursery beds of good soil, in drills 4 to 6 inches apart. When the seedlings are 3 or 4 inches high, they may be pricked out in the nursery. But a better plan is to let them grow to 6 inches, then transplant into bamboo baskets or cylindrical pots about 1 foot long and 3 inches diameter. The baskets or pots should be stacked on a layer of stone or brick under shade, and, when the rootlets begin to show, the seedlings should be put out during rainy weather in previously prepared pits at 4 to 6 feet apart. Another plan is to sow the seed broadcast in prepared nursery beds, to cover the seed lightly with sifted earth, and water freely. When the seedlings are three months old, they should be taken up, the roots being undisturbed, and transplanted to fresh beds. After a time they may be planted out in prepared pits at suitable distances apart.

Of the species of "gum trees" introduced into India, the following thrive best *in the* PLAINS of the Punjab:—*Eucalyptus citriodora* (with lemon scented leaves), *E. risinifera* (with leaves having a strong resinous smell), *E. rostrata*, *E. viminalis* (possibly), and many others. Both *E. citriodora* and *E. risinifera* seed in the plains, and seed may be procured locally from Lahore or other places where planted.

The seed should be sown in well-prepared and shaded nursery beds, or in pots with prepared soil. It will often be found a good plan to grow the seedlings in bamboo baskets and then plant out the basket and all; or the seed may be grown in pots and the pots broken when planting. The seedlings can in this way be planted without disturbing the earth round their roots. They should not be more than one year old when planted out.

Jaman.

Eugenia Jambolana. (Lam.)

A very handsome evergreen tree common throughout India, except in the arid regions of Sind and the South Punjab, and cultivated in the moister districts underlying the hills. In suitable climates it is adapted for growth along road-sides and, more especially, in groves near wells.

The wood is reddish brown, tough and hard; warps in seasoning, but fairly durable; used for building, agricultural implements, boats and canoes; bark is used for tanning and dyeing; fruit is much eaten by the natives, a vinegar is prepared from it which is used in diseases of the spleen.

It is propagated from seed which ripens in June-July, and should be sown as soon as gathered in nurseries only, several seeds being sown together and the healthiest seedlings kept. The young seedlings may be planted out afterwards near wells or river sides at the end of the cold weather, if irrigated; if not, during the rains. It does not require a deep soil. Succeeds well on a loam soil with boulders and gravel below the surface.

The tree untended yields a large quantity of indifferent fruit, but if treated as a fruit tree by grafting from selected trees; the fruit is good. It is worth cultivating along the banks of rivers and in positions where water is available, as once established it needs very little attention.

Another kind of Jaman (*E. latifolia*) gives better shade, but its fruit is very small and almost useless.

ROSE APPLE—GULAB JAMAN. *Eugenia Jambos.* (L.)—A small tree, a native of the Sikkim Terai, grown in the plains about Delhi, in the Kángra Valley, &c., and sometimes cultivated for its fruit; also for shade or ornament in gardens. The fruit is a rich pink and white berry, the size of a small apple, but dry and hardly worth eating.

It is easily propagated from seed, if sown when fresh as soon as ripe (July to August).

Cultivated in eastern parts of the Province.

THE TALLOW-TREE—CHARBI. *Excœcaria sebifera.* (Mull.)—A small-sized tree. Gives good shade. Very much like sissu in appearance. It is a native of China and Japan, introduced and cultivated throughout Northern India. The white pulp round the seeds, separated by boiling in water, gives the Chinese tallow used for candles in temples.

It is propagated from seed, which ripens in autumn, October to November. The seed should be sown in prepared nursery beds, and the seedlings transplanted during the rains.

Suitable for cultivation in the plains and lower hills up to 6,000 feet. Grown in Lahore gardens, Chánga Mánga Plantation, &c.

ELEPHANT OR WOOD APPLE—KAIT OR BILIN. *Feronia Elephantum.* (Corr.)—A small, handsome, erect-growing tree. Wild in South India, and occasionally found in the outer hills and Siwalik tract as far west as the Ravi, and cultivated throughout India, but not in the plains of the Punjab.

The wood is dark coloured, strong and durable, and used for house-building, domestic implements and carving. The bark yields a gum. The fruit (apple), which is the size of a cricket ball, is edible.

It is easily grown from seed; the fruit ripens about October and remains on the tree; after being gathered, they should be exposed to the sun for 10 or 15 days before sowing, so as to ripen them.

This tree is of slow growth, but is otherwise suitable for road-side purposes in the lower hills and eastern plains districts.

BANYAN TREE—BOR OR BARGAD.

Ficus bengalensis. (Linn.)

A large evergreen tree, with glossy, dark green leaves, spreading branches, which in moist climates send down numerous slender roots, which descend to the ground and afterwards become trunks. Grows wild in the forests of Bengal and Central India, and cultivated throughout the Punjab plains; when once established, will grow in nearly any description of soil.

The wood is not durable, but is used occasionally for boxes, door panels, and well rings. The root-drops are tough and elastic; a coarse brown cordage is made of them in the moist climates where they grow well. Bird-lime is made from the acrid milky juice. Leaves and twigs are a favourite fodder for cattle and elephants. The fruit is eaten during times of scarcity.

Propagated either from seed or from *cuttings.* The seed ripens in April or May, and should be sown in pots or in irrigated nursery beds, where the seedlings may be reared until fit to plant out. Broken bricks or charcoal mixed with the soil will assist the germination of the seed, and the young seedlings should be shaded at first from direct sun during the hottest hours of the day. Large cuttings, 8 to 10 feet high, planted at the commencement of the hot weather and well watered before and after the rains often succeed well, and handsome avenues of this species may be formed in this way in the moister districts.

This is an excellent avenue tree for shade, and grows well, except in the North and South of the Punjab, where the air is too dry or the winter too cold for it.

Another fig (*Ficus lucida*), a handsome tree, with a very dense shade, is grown in the Lahore Agri-Horticultural Gardens. It is reproduced from cuttings and layers, as the seed does not ripen well here. The cuttings are set in February.

Fig Tree—Anjir.

Ficus Carica. (L.)

Vernacular, Chenab, *phagwara, fagu;* Ravi, *jamir;* plains generally, *anjir, phagwara.*

A middle-sized tree, with large leaves, a native of Syria and Palestine, but cultivated for its fruit in the plains and in the outer hills of the Punjab and North-Western Provinces as high as 5,000 feet, also in the Deccan, Afghánistán, &c.

It may easily be raised from cuttings planted in a shady nursery bed until rooted, and then planted out.

This tree will grow very well in the Punjab in well-irrigated gardens with rich soil. The fruit when ripening will require careful protection from birds and insects. Small baskets or perforated boxes are sometimes used for this purpose. The fruit ripens from May to August.

Suitable for cultivation both in plains and outer hills.

Rumbal. *Ficus cordifolia.* (Roxb.)—A handsome tree, low in stature, with large green leaves and spreading branches; grows wild here and there in the Siwalik tract and along the hills as far as the Chenab, ascending to 5,000 feet.

The leaves are used as cattle fodder, and the fruit is eaten.

It grows readily from cuttings and also from seed.

Might be cultivated in the Siwaliks and along base of the hills.

Bat bar. *Ficus glomerata.* (Roxb).—A middle-sized tree; grows wild in the Siwalik tract and along the hills, generally on the banks of streams and rivers; often planted in the plains in the East Punjab.

The wood lasts well under water, otherwise not durable; used for well frames. The leaves are used for fodder. The ripe fruit is eaten.

It is grown from cuttings or from seed, which ripens April to July.

A handsome shady tree for avenues in the moister districts along the hills.

Palkhar. *Ficus infectoria.* (Willd.)—A large evergreen tree, with glossy dark green leaves; found wild in the Salt Range, Siwalik tract, and along the hills, ascending to 4,000 feet in the Punjab.

The leaves are used for fodder.

It grows rapidly from cuttings or from seed, which ripens in May to June.

A very handsome shady tree for avenues and gardens in the moister districts of the Punjab or where it would be well watered. Grows well in Hoshiárpur.

Pipal.

Ficus religiosa. (L.)

A well-known large tree, with irregularly shaped trunk and wide spreading branches. Indigenous near the hills in Bengal and Central India, but is found planted throughout India and in the Punjab, including the hills, up to 5,000 feet.

Wood is not strong or durable. The tree, being sacred, is not generally felled, the wood is suitable for fuel and to make packing cases; the twigs and leaves are favourite fodder for elephants; the leaves, bark and fruit are officinal in native medicine.

Easily propagated both from seed and cuttings, but the latter do not root freely or succeed well in the Punjab. The seed ripens in April to May, and should be sown in pots or in nurseries and watered until fit to plant out. As in the case of the banyan or "bor" tree, it is well to mix pounded bricks or charcoal with the soil of the seed-beds, and to shade the young seedlings at first. May be planted at end of cold weather, if irrigated, or, if not, during rains.

This tree grows well everywhere in the plains, except the north-west and south of the Punjab. It is valuable as a shade-giving tree. When used in avenues, they should be planted solely of this species, as it does not look well mixed with other kinds of trees. As it is sacred, it is not often injured when planted as a road-side tree.

FICUS RETUSA. (L.)—A fairly large tree, with small dark green leaves and dense foliage; grows wild in South India, Oudh, and many other places; frequently grown as an avenue tree; grows well, and is very hardy in tolerably moist warm climates.

It is easily grown from seed or from cuttings in the same way as other figs.

This is an excellent tree for avenue planting from its dense shade, and would probably thrive well in districts along the hills near water or where irrigated.

TREMAL. *Ficus roxburghii.* (Mig.)—A middle-sized tree, found wild in the Siwaliks and outer hills to 5,000 feet. The wood is harder than that of most other figs, the fruit is eaten and sold in the bazárs.

It is propagated by seed, which ripens in June, but better by cuttings or by layers. The cuttings should be set in the nursery and planted out during the rains when well rooted.

This tree grows well on dry soils with sunny aspects in the lower hills.

MOUNTAIN ASH.—SUM OR SUNNU.

Fraxinus floribunda. (Wall.)

Vernacular, Jhelum, *sum*; Chenab, *sinnu, shunnu*; Ravi, *sunnu.*

A large handsome tree, found here and there in deep rich soil in damp and shady situations throughout the hills at from 5,000 to 8,000 feet.

The wood is similar to English ash, hard, tough and elastic, much valued for plough-shafts, jhampán-poles, and considered to be the best wood for oars in Kashmir.

The tree is propagated from seed, which ripens in August-September, and should be sown in nurseries.

A very valuable and handsome tree for growing in shady, but well-drained, "dips" and flat places along the banks of streams in the hills.

KHARPAT. *Garuga pinnata.* (Roxb.)—A moderate-sized handsome tree, common in the dry hills in Central India and found along the hills as far as the Jamna; frequently associated with *Odina wodier*, which it resembles.

The wood is employed for in-door work and for fuel.

The fruits, which in outward appearance resemble grapes, are eaten, and the leaves are largely used for fodder.

It is very easily grown from large cuttings and also from seed.

This is a highly ornamental tree while in fruit, but, as it is leafless during the hot weather, is not a good road-side tree; useful for dry stony hill-sides and places along the hills.

KUMHAR. *Gmelina arborea.* (Roxb.)—A middle-sized light-green leaved tree, with yellow flowers; common throughout the greater part of India; grows wild along the hills ascending to 3,000 feet, but is scarce in the Punjab.

The wood is very much prized, does not warp, and is easily worked; lasts well under water; used for planking, furniture, &c., and a very great variety of purposes. The fruit is sometimes eaten.

It may easily be grown from seed or from cuttings. The seed ripens May to June. On being collected, the seed should be buried with dead leaves in a pit and kept in a moist state for a couple of months until the rains, when it should be sown at once in beds, which should be irrigated when the weather is dry. It may be more readily grown from cuttings if these are kept in the nursery until well rooted.

Should be tried in the lower hills.

PHALSA.

Grewia asiatica. (L.)

A small tree or shrub said to be wild in the Salt Range; cultivated throughout India for its fruit, which is acid and of agreeable flavour; used in preparing cooling drinks in the hot season.

It may be grown from seed, which ripens in May, but the propagation of the best sorts is done by layering. The long shoots should be well pruned after the crop is gathered.

This tree may be grown in any irrigated garden.

Dhamman.

Grewia oppositifolia. (Benth.)

A medium-sized tree, with a straight short trunk, common growing wild in all the lower hills up to 6,000 feet, occasionally in the Salt Range and other Punjab hills; frequently planted near villages and houses.

The wood is hard, elastic and very tough, used for oars, handles and bows; from the bark ropes are made; the chief use made of the tree is, however, to furnish fodder for sheep and goats during winter.

This tree is easily propagated from cuttings, or seed; is very hardy and grows almost on any soil in the lower hills.

Guatteria longifolia, Wall. (*Polyaltha longifolia.*) (Benth.)—A good-sized evergreen, handsome, shady tree, with a straight trunk and long dark-green glossy leaves; grows wild in Ceylon, commonly planted along roads in Bengal and South India and in Northern India as far west as Hoshiárpur. The fruit is eaten.

It grows well from seed, and thrives in stony situations. The seed ripens after the rains, and should be sown when quite fresh. Seed can be procured from any town where commonly planted, and is to be purchased in Poona.

This is a good avenue tree for the moister districts like Hoshiárpur, and looks particularly well planted in streets; does not transplant well, and is, therefore, sometimes sown direct in prepared pits, well manured and fenced.

Suitable for cultivation as an avenue tree in the eastern plains districts.

Chamhun. *Hovenia dulcis.* (Thunb.)—A moderate-sized, handsome, erect tree, indigenous in China, but commonly cultivated in Nepal, Sikkim, Kumaon, but rarely in the Punjab. The wood is not valuable, but the tree is cultivated for ornament and for its fruit. It is grown in the Anandale Gardens at Simla.

Himalayan holly. *Illex dipyrena.* (Wall.)—A small-sized evergreen tree, common in the hills from 6,000 to 9,000 feet.

The wood is not much esteemed locally, but makes good fuel; the leaves are occasionally lopped for fodder.

It is propagated from seed, which ripens August to October. Self-sown seedlings may easily be obtained where there are trees of this species. These may be reared in the nursery until fit to plant out.

Suitable for cultivation at high elevations.

Walnut tree.—Akhrot.

Juglans regia. (L.)

A large handsome tree; grows wild in the Himalayan forests up to 10,000 feet; largely cultivated near villages throughout the hills, and in Kashmir.

The wood, dark brown, often veined, very durable, works well and does not warp or split; is a beautiful furniture wood and polishes well; used for gun-stocks. The bark is used as a dye and in native medicine. The nut forms a very important article of food, and also yields an oil. The outer covering of the fruit is used as a dye and for tanning; the leaves furnish fodder.

Propagated from seed. The fruit ripens about September, and should be stored for sowing in bags in a dry, well-ventilated godown out of reach of vermin, or in pots or "gharas" and mixed with sand to protect it from mice

during the winter. The "gharas" should be closed with a piece of wood and buried under the ground. The seed should be sown either when it first ripens or in January or February in prepared nursery beds of fine rich mould, in drills 4½ to 6 inches apart, and covered with one to two inches of soil. The seed takes six months to germinate and requires to be protected from monkeys, &c. The nurseries should be well fenced and thorns put over beds. A surer way is to sow the seed in boxes or pots out of reach of vermin, and when the seedlings have come up to prick out into beds. When the seedlings are one year old, they should be transplanted in the nursery and their tap-roots shortened. When three years old, the young trees can be transplanted during the rains or winter into the open.

The walnut is an admirable avenue tree in dry shady localities in the hills. It fruits best in a well-drained soil in the vicinity of water.

KIGELIA PINNATA. An evergreen tree, with dark green foliage, and dark liver-coloured, flowers 3 inches in diameter.

Propagated from seed which ripens in August and September, and can be procured from the Royal Botanical Gardens, Calcutta. The seed, being very fine, should be sown in pots or boxes about March, and the seedlings transplanted when about a foot high. Requires to be slightly protected against frost.

Suitable for avenues and gardens. Grown in the Agri-Horticultural Gardens, Lahore.

MANGO—AM, AMB.

Mangifera indica. (L.)

A large, handsome, evergreen tree. The wild mango, of which the fruit tree is a cultivated variety, is indigenous in moist warm climates, though it is said to grow in the outer hills of the North-Western Provinces. It is cultivated throughout India, but practically disappears west of the Ravi. The wood is readily eaten by insects, but it is used for planking, doors and window frames; canoes and boats are made of it. Bark and leaves are used medicinally. A gum issues from wounds in the bark.

Cultivated for its fruit. It requires rich loam and a mild even climate. In the Punjab it must be protected from frost for two or three years. It is grown as a fruit tree in gardens near Delhi, Hoshiárpur, Gurdáspur, &c.

As a road-side ornamental tree it may be propagated from seed which ripens in June. The seed should be sown in a nursery or box filled with rich soil and well watered. It will germinate in 15 to 20 days. The young plants, transplanted during September, should be watered every two or three days. From November to March plants must be covered with grass to protect them from the frost.

This handsome tree thrives well near water or when well irrigated, but fails otherwise. It is suitable for road-side planting where there is good irrigation. The common sorts of mango are the best, for such situations, as the superior grafted kinds are much more delicate.

Cultivated as a fruit tree, grafting is necessary.—Most of the mango trees met with are of the ungrafted common country kinds; the flavour of the mangoes consequently varies considerably. Generally they are stringy and have a strong taste of turpentine. Mango grafts of the best Bombay and other kinds may be purchased at the Lahore Gardens, at Poona, and elsewhere. Where trees of a good variety already exist, grafts may be made from them on to common country seedlings. Most "málís" can do this. Grafting by approach or "*inarching*" is the commonest method. A mango tope may easily be

formed where there is a deep well-drained soil and irrigation is easy. Stagnant water about the roots of the trees is, however, fatal to them. Seedlings can be raised in boxes from seed, and these may be grafted or not as required. The young trees, grafts, or seedlings should be planted out in pits well manured and watered 20 feet apart. During the cold weather they require to be protected from frost. In native gardens, plantain trees are very frequently planted alongside the young mango trees while small. It is supposed that they keep white-ants from attacking the trees and keep the roots moist. In the Punjab, good mangoes are grown at Hoshiárpur, Delhi, Gurdáspur, and in nearly all old gardens about Lahore, Amritsar, &c.

Persian Lilac—Bakain.

Melia Azedarach. (L.)

A moderate-sized tree, with handsome lilac flowers, which grows wild in Bilúchistán, and is believed to be indigenous in the Lower Himalaya and the Siwalik tract.

Commonly cultivated throughout India, and flourishes in the north and north-west of the Punjab.

The wood is brownish white, or reddish, coarse fibred, warps and splits; the wood of old trees is often handsomely marked and used for furniture. Bark is extremely bitter, leaves and pulp of the fruit are used in native medicine. From the fruit an oil is extracted. It is *propagated* from seed, which ripens in January and February, and should be sown as soon as gathered when quite fresh, as it does not retain its germinating powers long. The young seedlings may be planted out at the end of the cold weather or during the rains. They are best planted with earth round the roots.

This is a good tree for shade and ornament in streets and stations, where it grows well and rapidly if irrigated, but it is less suited for country roads, where many finer trees can be grown as easily. Its roots are shallow, spreading near the surface, and it is, in consequence, easily blown over.

Nim.

Melia indica. (L.)

A large evergreen tree, common throughout the greater part of India as far west as the Sutlej, planted or self-sown, but beyond Jhelum it disappears altogether.

The wood is red or brown, compact, sometimes resembles mahogany, takes a beautiful polish, is fairly durable, is so bitter that white-ants and other insects will not touch it. It is used for construction, cart-building, ship-building, and agricultural implements; is held sacred by the Hindús and used for making idols. The sap is used medicinally; a gum, used as a stimulant, exudes from the bark. From the fruit an oil is extracted. The leaves are used medicinally, and the bark is sometimes used as a substitute for Peruvian bark.

It is propagated from seed which ripens in July and August, and should be sown in well-prepared nursery beds, as the young plants are liable to suffer from frost. The seedlings may be planted out with earth round the roots in December or during the rains. The transplants require but little watering, and that only until the beginning of the rains.

This tree is very hardy and will grow almost anywhere. It gives good shade if watered, but if not irrigated loses its leaves in the hot weather. It is valuable for planting near villages and wells and in plots on grazing-grounds. The growth is fairly quick, and it coppices well when cut.

CHAMBA. *Michelia champaca.* (L).—A large handsome evergreen tree, somewhat resembling the mango, with sweet-scented yellow flowers, which appear in the hot weather; cultivated throughout India, particularly at Hindu shrines, as far as the Ravi and found in Kángra, where it was one of the "Pádsháhi" (Royal) trees.

The wood is very much esteemed for furniture, carriage work, &c. It is easily propagated from seed, which ripens November to December, and may be procured from anywhere it is grown, notably Abu. It will thrive well in irrigated gardens.

Millingtonia hortensis. (L).—A tall graceful tree, with dark-green leaves and clusters of white-scented flowers, a native of Burma, but cultivated in avenues and gardens in most parts of India; common about Umballa, Delhi, &c.

It is easily grown from root-suckers, which can be dug up and planted out: in Northern India the tree seeds very rarely.

This ornamental tree is very suitable for groves, as it grows with little water and in shallow soil; but the tall stem is apt to be broken by the wind, so that it is less suited for avenues along frequented roads.

KHIRNI. *Mimusops indica.* (A. DC.)—A beautiful small evergreen tree, with dark glossy leaves. Grows wild in South and Central India and in the sandy soils of Gujrát. Commonly grown near villages in many parts of India as far west as Lahore, Mooltan and Gujránwála.

The wood is heavy, hard, and tough; is excellent for turning and is used for many domestic purposes. The fruit is eaten, but it is more worth cultivating as a tree than for its fruit.

It is grown easily from seed, and thrives wherever water is not very far from the surface or where irrigated. Grows to a great age, and gives very good shade, and would probably grow well in sandy soils in the Punjab near rivers.

HORSE RADISH TREE—SOHANJNA.

Moringa pterygosperma. (Gaert.)

A small tree, with light foliage and sweet-scented white flowers, grows wild in the Siwalik region in the Eastern Punjab, and is seen commonly planted throughout the Province up to 1,200 to 1,500 feet; also commonly cultivated throughout the whole of India.

The fruit ripens about April, and is eaten by the natives; twigs and leaves are lopped for fodder. The wood is excessively soft and quite useless, and said to be not even fit for fuel. The roots have the flavour of horse radish and are occasionally used for it.

It is propagated from seed, but thick cuttings do better, as the sowings are not always successful. Seed ripens in April, and should be sown in well-prepared beds in a nursery, and the seedlings transplanted during rains or spring. It requires a good deal of irrigation or heavy rainfall. It is not long-lived enough to make a good avenue tree and its growth is unsymmetrical; but, with other trees in an avenue, it has a good appearance from the beauty of its flowers. It is leafless during part of the year.

MULBERRY—TUT.

Morus alba. (Willd.)

A handsome middle-sized deciduous tree, sometimes attaining a very large size. It grows wild throughout the Punjab plains and in the hills up to 5,000 feet. The wood polishes well, and is strong and useful, much employed for building, furniture, and agricultural implements. The leaves are largely used as fodder and for feeding silkworms. But the chief product of this tree is its fruit, of which there are many varieties of all shades of colour, from white to a blackish purple, much eaten by the natives.

It is easily propagated either from seed or from cuttings. The seed ripens in May to June, and should be sown in June or beginning of July. It is easy to raise plants in the nursery and to transplant them. On irrigated land it may be sown on ridges up to middle of July. The plants require to be watered up to the end of October or later, and are easily affected by drought. The

young plants may be transplanted, with or without earth, during December, January and February. Provided the soil is moist enough, even plants with half injured roots will grow readily.

This tree grows well and fast when irrigated. But after a certain age the tree becomes diseased, so rarely produces good timber. It is frequently cultivated for its fruit by grafting a superior variety of cultivated mulberry, called "Shah-tút," on to seedlings of the wild mulberry. The operation is very easily done at the end of the cold weather, young seedlings being raised for the purpose by seed sown in drills in a nursery. These seedlings are cut off a foot from the ground and budded when one to two years old.

Cultivated throughout the plains and the lower hills.

HIMALAYAN MULBERRY—KARUN. *Morus Serrata.* (Roxb.)—A large deciduous tree, found wild here and there in many parts of the hills at from 4,000 to 9,000 feet, but descending much lower in places. Cultivated near villages.

The wood is easily worked, and not heavy, polishes beautifully, and might answer for cabinet work. It is used for agricultural implements, toys, &c.

Propagated by seed, or cuttings, or by root-suckers. The seed ripens June to August. Cuttings should be made during the rains and set in the nursery until well rooted; and may be planted out during the following rains.

Suitable for cultivation in the hills.

PLANTAIN—KELA.

Musa Paradisiaca. (L.)

Grows wild in the moist forests of tropical and sub-tropical India.

It is largely cultivated in some parts of the eastern plains districts and in the outer hills up to 4,000 feet; becomes very rare towards the north-west, and the quality of the fruit is not so good in the Punjab as in the east and south of India.

The fruit is largely eaten, both raw and cooked as a vegetable, and is very nutritious.

Propagated by root-suckers, which spring up from the roots. To make a plantation, the shoots from the base of old trees should be dug out, the decayed parts cut off, the sound shoots soaked in water, and then planted out in a trench dug three feet deep and filled in with a mixture of two-thirds stall manure and one-third earth. The best time to plant is during the rains or end of the cold season. Plenty of water every three or four days and free drainage will be necessary.

Plantains require constant moisture and heavy manuring, and are best grown along a trench leading from a well or irrigation canal, where they can be kept pretty regularly irrigated.

There are a very great number of superior varieties of the plantain. Most of the best kinds may be purchased at Lahore, Saháranpur, and other public nurseries. The plantain grows best in a moist warm climate, and although it will grow, if sufficiently irrigated, does not yield very good fruit in the Punjab.

KEMAL. *Odina Wodier.* (Roxb.)—A large deciduous tree, with few branches.

Common in dry forests throughout India as far as the Indus, and found in the Punjab in the outer hills as high as 4,000 feet.

The wood is used for spear shafts, scabbards, wheel spokes, cattle yokes, oil-presses, and rice-pounders. It polishes well and is very heavy, and yields a gum.

The best mode of propagating this tree artificially is not known. The fruit ripens from June onwards, and remains a long time on the tree.

Recommended for cultivation in the lower hills.

Olive—Kau.

Olea cuspidata. (Wall.)

A middle-sized tree; common, growing wild in the Punjab Salt Range and in the outer hills of the North-Western Himalayas up to 6,000 feet.

The wood is very hard and takes a beautiful polish, is highly prized for turning, for the rib timbers of boats (on the Indus), and agricultural implements; combs are carved from it. It yields excellent fuel and makes good charcoal, and the tree is lopped for fodder.

The cultivated olive is propagated by taking the root-suckers, which spring up near the parent stem, and planting them out, the good varieties being grafted on to these stems. Has generally been reproduced by seed in India. The seed ripens August to November; should be sown at end of cold weather in well-prepared nursery beds or pots in a soil mixed with charcoal and carefully watered. The seedlings should be planted out in April, if irrigated, or during the rains.

Although (if not the same as some maintain) it is closely allied to the European olive, there is no trace of its ever having been cultivated or its fruit turned to account in India. The wild variety yields very little oil, not enough to repay cultivation, but might be improved by grafting or budding with European varieties.

Should be cultivated in suitable localities, such as Salt Range and outer hills.

Date-palm—Khajur.

Phœnix dactilifera. (L.)

A tall palm, producing an edible fruit, grows wild in Mooltan, Muzaffargarh, and the south of Punjab and Sind.

Highly cultivated in Persia and Arabia, in parts of which countries it forms one of the chief sources of food of the population during certain seasons, and from whence it is largely exported.

Propagated from shoots or from seed. If grown from seed as a fruit tree, imported stones should be procured, as the dates growing wild in the Punjab are very inferior and not worth the money spent on cultivating them. The seed should be sown as soon after it ripens (early in August) as procurable, along drills 6 to 12 inches apart in nursery beds, and the young plants may be planted out when one year old, or better when two years old, after being transplanted once in the nursery. The date-palm is, however, best propagated by *offsets*, as the seed does not always come true. Offsets from female trees of good varieties, having about one foot of woody stem, should be planted in September or October in the nursery until rooted. They can then be planted out in the following rains. They will require a little watering during the hot weather until they flower (6 to 10 years). If shoots from female (fruit-bearing) stems only are taken, they will require to be artificially fertilized; otherwise male stems should be planted with the fruit-bearing stems.

Should be cultivated in the dry districts.

Amla. *Phyllanthus Emblica.* (L.)—A moderate-sized deciduous tree, grows wild in the forests of most parts of North India, and the drier parts of the forests of Burma and Assam; found in the lower hills of the Punjab, and planted in irrigated gardens in the plains.

Wood is durable under water, is used for well work, also for implements, building, and furniture; bark is used for dyeing, tanning and medicine, and fruit for food and preserves.

Note.—For full particulars regarding the cultivation of this palm *see* "Date-palm in India," by E. Bonavia, M. D., Thacker, Spink and Co., Calcutta, 1885.

Grown from seed which ripens during the cold weather and should be sown soon after being gathered, before the commencement of the hot weather. Young trees should be planted out during the rains, or, if irrigated, in the early hot weather.

The intensely acid fruit of this tree is liked by natives, but it is more worth cultivating on account of its handsome feathery leaves than for its fruit.

Planted in lower hills and in gardens in the plains.

Blue Pine—Kail.

Pinus excelsa. (Wall.)

Vernacular—Jhelum, *biar*; Chenab, *chir, kachir, darchir*; Ravi, *chil*; Beas, *kail*; Sutlej, *kail.*

A large tree, with bluish-green foliage, common in the hills from 5,000 to 11,000 feet in mixed forests, extending to the more arid regions of the inner ranges and preferring dry stony slopes and open places.

Wood light-brown, compact, even-grained, ranks next to deodár as regards durability, and is used for construction when that species is not to be obtained. It is said to be the best wood in the Punjab for pattern-making, and yields excellent charcoal for iron-smelting. Turpentine, resin and tar might be obtained from this tree.

Propagated from seed, which ripens in October or end of the autumn, and falls leaving the cones on the tree. To collect the seeds, their ripening of the cones must be watched and the cones gathered just before the scales open, slightly heated, and the seeds picked out. The seed should be sown when ripe in nursery beds, in drills 6 inches apart, in November or December, or it may be kept until after the winter and sown in the spring. Seedlings should be planted out during the rains when tall enough to hold their own.

A handsome tree for planting about a hill station on open well-drained slopes.

Chil—Pine—Chil.

Pinus longifolia. (Roxb.)

A large tree, with symmetrical branches high up on the trunk forming a rounded head of light foliage.

Very common throughout the outer hills from 2,000 to 5,000 feet and even higher, and cultivated in the plains in gardens at Ráwalpindi, Lahore, &c.

Wood white to brown, easy to work, and used in the hills for building, shingles and tea-boxes, but is not durable; is attacked by insects, and decays rapidly when exposed to the wet. Yields turpentine and resin, which is obtained by making incisions in the stem or by stripping off the bark. The seeds are eaten by natives in times of scarcity.

Propagated from seed, which ripens October to November, but the cones do not open to let fall the seed until April. To collect the seed, the cones should be gathered during the winter months, December to March. To extract seed, which is a difficult operation owing to the large amount of resin, the cones should be slightly heated and the seed picked out. The seed should be sown in the beginning of March or before rains in nursery beds, in drills 6 inches apart, or broadcast thickly. Nurseries may be made on somewhat poor soil, which need not be dug up very deeply. This species is so easy to reproduce that it may sometimes be sown broadcast, in drills or along trenches, or even in prepared spots or holes along road-sides, if these places are well fenced in with dry thorns or otherwise. If sown in a nursery, the seedlings should be transplanted during spring or beginning of rains. Care

must be taken not to injure the tap-root of the seedlings, and they must be planted with earth round their roots. The seedlings can be transplanted as yearlings or as plants two years old.

The chil pine is a good road-side tree for hot dry slopes in the lower hills.

Kakkar.

Pistacia integerrima. (Hf. and T.)

A fairly large tree, grows wild in the hills from 1,500 to 5,600 feet and in the Salt Range. Is most common in parts of Hazára; found growing on hot aspects in dry rocky ground with moist air.

The heart-wood of mature trees, known as zebra wood, is beautifully mottled or striped with yellow or dark veins, and takes a fine polish. It is the best and most handsome wood of the North-West Himalayas for carving, furniture, &c. The sapwood is liable to be attacked by insects. The tree is lopped severely for fodder for buffaloes and camels, and uninjured trees of large size are now not to be found.

Propagated from seed, but is very shy of germinating. The seed ripens in October, and should be sown in well-prepared and well-drained nursery beds, or in pots with prepared soil. The seedlings should be planted out in the rains, but not until well grown, in dry situations, and occasionally watered while young during May and June.

This tree merits more attention than it has hitherto received, and might be cultivated in groves with other kinds for its beautiful wood. But the trees would require to be very carefully fenced, as the leaves are greedily devoured by cattle and goats, and it will always be lopped if not strictly protected. Some beautiful specimens of this species, with short stem and large branching crown, may be seen in the Agri-Horticultural Garden, Lahore.

Plane tree—Chinar.

Platanus orientalis. (L.)

A large deciduous tree, grows to a great size, and rather fast; a very shady tree, with large lobed leaves.

Indigenous in Greece, Armenia, &c., but is largely cultivated in Kashmir and in the North-Western Himalayas; grows at from 2,000 to over 8,000 feet.

The wood resembles beech, is compact, but not strong, used in Kashmir for making small articles, which are afterwards lacquered. It takes, however, a beautiful polish and has a handsome mottled grain.

May be propagated readily from seed or cuttings, and may be grown in any of the moister plains districts wherever the soil is good. Cultivated in the lower hills.

The Gold-mohr Tree. *Poinciana regia.* (Bojer.)—A very showy tree, with large bright scarlet flowers; a native of Madagascar; commonly grows in gardens throughout India north-west as far as Jamna.

Easily grown from seed. To prepare the seed for germination, it should be placed in a "ghara" and buried in a dung-pit or other moist place before being sown in the rains. It is said that this tree is very commonly propagated by cuttings in Sind. In the Punjab it will not stand the frost of the plains.

Indian beech—Sukhchein. *Pongamia glabra.* (Vent.)—A very beautiful moderate-sized tree, almost evergreen, with dark green glossy and singularly graceful foliage.

Common, growing wild near banks of streams and water-courses and elsewhere in moist localities in South and Central India and Bengal; also found, but not common, at the foot of the Punjab Himalayas and outer valleys to 2,000 feet, as far west as the Ravi.

Grows very rapidly from seed when near water. The fruit ripens in April, and should be sown at once when gathered. The wood is readily eaten by insects.

A very handsome tree worthy of cultivation in moist localities or along canals, streams, &c. The tree is apt to form awkward elbow branches and requires careful pruning.

BAHN. *Populus euphratica.* (Olive.)—A large tree, common, growing wild in Sind along the Indus and in the Southern Punjab in the low and often flooded lands along rivers.

The wood is largely used in Sind for beams and rafters of houses and for turning, but is not much valued in the South Punjab, except for fuel. Sind lacquered boxes are made of this wood.

Easily grown from root-suckers, which the tree throws out in abundance. The seedlings spring up in abundance on the mud after the annual floods of the rivers along which it grows.

HIMALAYAN POPLAR. *Populus ciliata.* (Wall.)—A large tree, growing wild in the hills from 4,000 to 10,000 feet, most common north-west of Jamna; abounds in the Chamba forests.

Wood used for water-troughs; leaves as fodder for goats.

Propagated from cuttings, which are made in June-July, and may be planted out direct in moist places. Large stakes, 9 to 10 feet, put down as fencing in such localities rapidly strike. Rooted cuttings or large stakes may be planted along roads during the rains.

Suitable for cultivation in moist places in the hills.

BLACK POPLAR—SAFEDAR.

Populus nigra. (Lin.)

A large tree with spreading erect branches. Planted in the north-western Himalaya, particularly in Kashmir and in the basins of Jhelum, Chenab and Sutlej rivers between 3,000 and 11,500 feet. Occasionally planted in the plains at Lahore, Pesháwar, Hoshiárpur and elsewhere.

Propagated from cuttings.

This tree is very useful as an avenue tree; a very fine specimen of a poplar avenue may be seen near Sirinagar in Kashmir.

WHITE POPLAR. *Populus alba.* (L.)—A large tree, wild, and cultivated in the north-western Himalaya between 4,000 and 10,000 feet on the Jhelum, Chenab and planted in the Pesháwar valley, in the Punjab plains (not common) and in Sind.

Wood not much valued in India.

Generally propagated from large cuttings, as the above species.

Suitable for cultivation in the hills; might be tried in the plains.

JHAND.

Prosopis spicigera. (L.)

A moderate-sized thorny tree, a native of the dry rakhs in the Punjab, Sind and Rájpútána.

The wood is tough, but not durable, liable to dry rot and readily eaten by insects, used for carts, agricultural implements and well-curbs; good fuel for steamers and locomotives. The fruit pods are much used as fodder, and the brown mealy substance which surrounds the seed is eaten by the natives. Branches and leaves lopped and browsed to excess.

May be propagated by transplanting root-suckers or by seed, which ripens in June, and may be sown during the rains direct or at once, when gathered, in nursery beds if irrigated. Is usually sown on ridges. On irrigated land it may be sown any time after the cold weather. The seedlings may be planted out during the rains or in spring.

This tree sends its roots deep down into the soil and has great power of coppicing; it is very well adapted for cultivation in dry districts.

Almond—Badam.

Prunus amygdalus.

A moderate-sized tree, very showy when in flower; a native of the Caucasus; largely cultivated for its fruit in Persia, whence large quantities of sweet and also bitter almonds are exported; cultivated also in Kashmir and in the plains of the Punjab, but in the latter place the fruit is scanty and inferior.

Almond trees may readily be raised from seed in the plains by sowing fresh almonds imported from the Persian Gulf. But such trees do not, as a rule, seed in the plains unless budded on to a peach or apricot stock.

In the hills, almonds are raised from seed both for the fruit and to serve as stocks for apricots and peaches. The seed should be sown in December or January. It takes six months to germinate, and requires to be protected from monkeys, &c., when sown.

Apricot—Chir.

Prunus armeniaca. (L).

A small or moderate-sized tree, believed to be a native of the Caucasus, and cultivated for its fruit along the hills up to high elevations.

The wood is not used for any special purpose. The fruit is eaten green or dried; in some places an oil is extracted from the kernels.

May be readily raised from seed, or better by importing seed of the European varieties and budding seedlings grown from these on to seedlings of the country varieties or on to stocks of the almond.

Apricots will grow very well, as broad spreading shrubs, in the plains, in a good soil and in cool situations, but only thrive as fruit trees in the hills at from 5,000 to 8,000 feet. There is no fruit more generally grown or that will thrive better in the hills. When planted in groves or orchards, should not be planted close; about 25 feet apart will be best.

Cherry—Gilas.

Prunus cerasus. (L).

A moderate-sized tree, grows wild in Western Asia, and naturalized in Europe. Several varieties of cherries are cultivated for their fruit in Kashmir, Bashahr, Pangi and elsewhere in the Punjab Himalayas between 5,000 and 8,000 feet.

The fruit ripens in June-July, and the tree may be propagated either by seed or by root-suckers. The seedlings should be planted 12 feet apart.

Does not grow in the plains.

Plum—Alucha.

Prunus communis. (Hud.)

A small-sized tree, universally cultivated for its fruit; largely grown in Kashmir and Afghánistán at from 5,000 to 7,000 feet, and at places in the plains of the Punjab.

Nearly all the best English varieties of plums can be grown in the hills by budding them on country stocks in the same way as oranges are budded, or from cuttings. The latter make more shapely trees. The stocks can be grown from

seed in the ordinary way. The grafts may be planted out in orchards when from one to three years old. Cuttings of good varieties will also give excellent fruits.

Indigenous plum trees may also be grown from seed without any difficulty, but the fruit is inferior. The finer European varieties cannot be grown in the plains, but some good native kinds are got from Saháranpur, and are cultivated, about Delhi and other large towns, generally by budding on the wild stock. These trees will not grow well unless planted at about 20 feet apart.

BIRD CHERRY—JAMU. *Prunus Padus.* (L.)—A moderate-sized deciduous tree found throughout Central Europe and Asia and common, growing wild in the hill forests from 4,000 to 10,000 feet. Occasionally planted.

The wood takes a fine polish. In France it is used by cabinet-makers, and it is sometimes used for furniture in the hill stations in India. The fruit is eaten by the hill people, and the leaves (said to be poisonous when young) are used as fodder when dry and as manure in rice fields.

Propagated by seed, by cuttings, and by layers. The seed ripens July to October, generally after the rains in September, and may be sown when ripe or in the following April. For keeping, the fleshy portion of the seed should be rubbed or rotted off, or *stones* procured from the hill-men who eat the fruit. Stones from fruits eaten by bears, which are very fond of this fruit, germinate freely. The seed may be sown in nursery beds, broadcast or in drills. Young seedlings three years old are generally tall enough to be put out. As the foliage is sparse, the seedlings should be planted close for groves.

This is a good tree for planting in moist shady localities on well-drained soil in the hills at an elevation of from 6,000 to 8,000 feet.

PEACH—ARU.

Prunus persica. (Benth.)

The peach (fruit with velvety, and nectarine, with smooth skin) is a moderate-sized tree with dark green foliage.

It was originally a native of China, but is naturalized in Europe and in the north-west Himalayas generally between 3,000 and 6,000 feet. Cultivated for its fruit throughout the Himalayas up to high elevations, and in the plains of the Punjab and elsewhere.

The wood of peach trees past bearing is very hard, and is useful for many purposes. Seedlings may be raised from seed in the ordinary way, and good varieties can be propagated to any extent by grafting on these stocks. Or good grafted seedlings of good varieties may be purchased from the Lahore or Saháranpur gardens.

With care very good peaches can be grown in any garden in the plains, and finer varieties in the hills at the height of the hill stations. The chief varieties grown about Lahore by native gardeners are the pointed "noki," and the flat "chakki" or "tikki". This tree requires careful manuring, irrigating and tending. The blossoms are apt to be killed by frost, and a small beetle at times strips the tree of its leaves. The seed takes six months or more to germinate, and requires to be protected from monkeys, &c., when sown. The trees should be planted 15 feet apart.

PAJJA. *Prunus puddum.* (Roxb.)—A handsome and moderate-sized tree, wild and frequently cultivated in the hills between 2,500 and 7,000 feet.

The wood is prized for walking sticks. The fruit is acid, and is not much eaten.

May be grown from seed, which ripens in April.

A good road-side tree in the hills on well-drained soil and a sunny aspect.

GUAVA—AMRUT, AMRUD.

Psidium guava. (Raddi.)

A small tree, a native of Mexico and other parts of tropical America, cultivated for its fruit throughout India, except in the north-west corner of the Punjab.

The wood is compact and close-grained, and takes a beautiful polish. The fruit is excellent, and is much esteemed by natives.

Generally grown from seed, which should be sown when ripe during the rains. Seed from a really good fruit-bearing tree will often give excellent results.

Superior varieties of this popular fruit may easily be propagated by layering, and the result will well repay the cost of operation. The guava requires a deep sandy loam soil and liberal irrigation and manuring. When old the tree should be pollarded. Grows well in gardens of the plains.

Pterospermum Acerifolium. (Will.)—A remarkably beautiful tree, with very large dark green and white leaves and white flowers.

Grows wild in Burma, where it attains a very large size, and along the hills in the Dún. Cultivated throughout India, but not in the Punjab.

Easily grown from seed and also by layers. Seed can be procured from Bombay and Calcutta in the cold season.

It is a favourite road-side tree in Bombay and Calcutta, and would probably grow well in the east of the Punjab if irrigated. A highly ornamental tree for public gardens, &c.

Pomegranate—Anar.

Punica Granatum. (L.)

A shrub or small tree, grows wild in the hills of the Punjab and Kashmir, and very abundant up to 5,000 feet in Afghánistán, where it is extensively cultivated and from whence the fruit is largely imported into India. Is also commonly cultivated in gardens in the Punjab for its fruit and handsome red flowers.

Wood, white or yellowish white, close and even-grained, hard, heavy, and takes a fine polish. The fruit is eaten and made into "sherbets," and that with an acid taste is generally dried and sold in the "bazárs." The rind, called *naspál,* is extensively used in tanning and dyeing.

Propagated easily from cuttings and also from seed, which ripens July to September. Select varieties, which bear fruit of good flavour with fine seeds, may be raised by inarching on to an ordinary seedling.

Would probably thrive well in the climate of the North-West Punjab.

Putajan. *Putranjiva Roxburghii.* (Wall.)—A middle-sized evergreen tree, with dark green foliage, common in places in lower hills, ascending to 2,500 feet and extending west to Chenab and occasionally planted in or near the Siwaliks.

Wood used for tools and in turning. The leaves are lopped for cattle fodder; the nuts are strung up in rosaries and in necklaces for children.

Propagated from seed, which ripens January to June.

This tree is generally found in low shady moist mixed forests; is a fine shady tree, and merits extended cultivation as a road-side tree in suitable localities.

Pear—Naspati.

Pyrus communis. (L.)

A good-sized tree, a native of colder parts of Asia and Central Europe. Believed to be wild in Kashmir, and cultivated on account of its fruit in the north west Himalayas between 2,000 and 8,000 feet, and is occasionally cultivated in the plains, but there it produces a wretched fruit.

Propagated from seed or from cuttings which have been set in nurseries. In the hills the wild pear grows well, but the fruit is worthless. Good English varieties can, however, be successfully grafted on the wild stock with excellent results. The stocks can be very easily grown from the seed or cuttings of the wild pear, or better from root-suckers. Fruit should be allowed to decay partially and then crushed and the seed and pulp sown together.

Grows well on clayey, moist soils. Grafts of superior varieties will not, as a rule, fruit at all in the plains, but it is well worth cultivating in the hills. When planted in groves or orchards, the trees should be planted about 24 feet apart.

Apple—Seo.

Pyrus malus. (L.)

A moderate-sized tree, a native of the colder parts of Asia and Persia, but naturalized or wild in Europe and the north-west Himalayas at high elevations. It is grown in gardens in Sind and the plains of the Punjab and the Deccan, &c., and in many places produces good fruit.

The common country apple is propagated in the plains by root-suckers taken from the parent tree. Finer varieties of apples are propagated by budding in the gardens about Delhi, but the English varieties will not fruit in the plains. In the hills, apples of the finest description can only be grown from imported varieties, and these can be propagated to any extent by grafting or budding on seedlings of the country apple; also by layering the English apple trees.

When planted in groves or orchards, will not grow well if planted close; about 24 feet apart will be best.

Wild Pear—Kaint. *Pyrus variolosa.* (Wall.)—A moderate-sized tree common in the hills from 3,000 to 8,000 feet. Occasionally cultivated. A few trees are cultivated in the Lahore gardens.

Various implements are made of the wood. The fruit is occasionally eaten, but not until it is nearly rotten.

Easily grown from the seed, cuttings, or root-suckers. The first method is the best. The fruit ripens in the autumn after the rains. The fruit should be allowed to decay partially and then crushed and the seed and pulp sown together.

This tree grows well on clayey, moist soil, and is a hardy useful road-side tree in the hills. Also makes an excellent stock to graft superior varieties of the pear on.

Banni. *Quercus annulata.* (Sm.)—A large or middle-sized evergreen tree. The lowest growing of the hill oaks. Common in the valleys of the great rivers in the outer ranges of the hills ascending to 5,000 feet, and generally growing on warm, dry slopes. With the grey oak, this tree forms coppice in the Kángra Valley with standards of "Ohi."

The wood is much the same as that of the grey oak, but is less used.

Propagated from seed, which ripens after the rains, August to October, and should be sown at once when ripe, and treated in the same way as silver oak.

This tree is suitable for planting at lower elevations and in drier and warmer situations than any of the other hill oaks. It is, however, a slow-growing tree. It will not thrive if planted in shade.

Moru. *Quercus dilatata.* (Lind.)—A large evergreen tree, common throughout the outer ranges of the hills from 5,000 to 9,000 feet.

The wood is largely used for building, agricultural implements, jhampán poles, &c., and is more prized than any other hill oak for these purposes and for fuel and charcoal. The leaves are commonly lopped for fodder.

Propagated from seed, which ripens during the rains and should be sown at once as soon as gathered in the same manner as other oaks.

This tree is very commonly found growing in the mid zone between the silver or grey oak below and the brown oak above, and is very suitable for road-side and grove-planting at high elevations.

Grey Oak—Ban.

Quercus incana. (Rox.)

A large evergreen tree with grey foliage. The commonest of all oaks in the hills. Very common throughout the hill forests from 3,000 to 8,000 feet. Not found in the Kashmir hills or the inner ranges, where the rainfall is small.

The wood is brown, very hard and heavy. Used for building and ploughs, and especially esteemed for fuel and for making charcoal. The bark is used for tanning, and the leaves are very much valued for fodder for cattle.

Propagated from seed, which, as it does not keep well and begins to grow directly it has fallen from the trees, should be sown as soon as ripe in lines in well-drained nursery beds. In protected places it may be sown direct, and thus all trouble in transplanting is avoided. The seedlings should not be planted out until four or five years old, and therefore required to be transplanted in the nursery. Self-sown seedlings may also be collected when very young and reared in the nursery for planting out.

The grey oak is a very good road-side tree in dry shady localities at the elevations at which it grows.

BROWN OAK—KHARSU. *Quercus semecarpifolia.* (Sm.)—A large tree found at very high elevations between 8,000 and 10,000, occasionally ascending to 12,000 feet, throughout the hill forests. It often forms forests to the exclusion of all other trees, except the birch, at the upper limit of forest vegetation.

The wood is used locally for building, furniture and agricultural implements, and yields excellent charcoal and fuel. The leaves are stored as winter fodder in the hills. Owing to the localities in which this tree grows, it has not been exported.

Propagated from seed, which ripens in the autumn after the rains, and should be sown *at once* as soon as ripe, as it does not keep and begins to grow directly it falls from the tree. In protected places it may be sown direct, and thus all trouble in transplanting is avoided. The seedlings will not be tall enough to plant out for four or five years.

This tree could be used for road-sides as groves at very high elevations where other trees would not grow.

RHODODENDRON.

Rhododendron arboreum. (Sm.)

Vernacular—Jhelum, *ardáwal*; Chenab, *mandel*; Ravi, *chiú, aru*; Beas, *bras, broa, chacheon*; Sutlej, *brás.*

A well-known small tree, with grey foliage and handsome flowers, which appear March to May; common throughout the outer ranges of the hills from 4,000 to 8,000 feet and much higher in places.

The wood is brown, close-grained and hard. Is sometimes employed in building, and yields most excellent fuel and charcoal. The young leaves are believed to be poisonous to cattle. The flowers are eaten and are used as an ornament.

Propagated from seed, which ripens May to June at low elevations, and as late as January and February at high elevations. The seed should be sown when gathered in well-prepared nursery beds. Self-sown seedlings of this tree can generally be collected where it is growing, and reared in the nursery until large enough to plant out.

Suitable for growing in sheltered places on slopes of the hills with well-drained rich soils, especially under moderate shade, and may be associated with any of the hill oaks.

Robinia—(*Robinia pseudo-acacia.*) (L.)

A middle-sized tree, with very beautiful foliage. A native of North America, but acclimatised in Europe for the last couple of centuries, especially in Italy and the Southern Alps, where it is used for fixing embankments, &c.

Wood hard, strong, durable, particularly eligible for axle-trees, shafts, turnery, &c.

Easily propagated, either from seed, root-suckers and less readily from cuttings.

The tree seeds in this country, but large supplies are more easily obtained from seed dealers in Italy.

This tree is of very rapid growth, and is one of the best trees for renovating exhausted soils and especially for covering bare slopes in the hills. Its roots spread very rapidly, forming a net-work in the surface-soil. Treated as coppice, it forms a dense thicket. It thrives admirably at Simla.

RHUS SP.—There are very many species of these handsome foliage trees found throughout the outer hill forests, mostly in moist places. The sap of many of them blisters the skin. The more common of them are,—*Rhus succedanea*, *R. panjabensis*, *R. vernicifera*, *R. semialata*, *R. wallichi*. But there is confusion among their native names, and most of them are called arkhar, arkhol, titri, &c.

Propagated from seed which ripens in autumn, and should be sown at once in the nurseries.

These species grow on loam, sand or clay, provided there is plenty of moisture and are worth cultivating in moist places along rivers, &c., in the lower hills.

WEEPING WILLOW.

Salix babylonica. (L.)

Vernacular—Chenab, *bidai*, *bitsu*; Ravi and Beas, *badá*; plains, *bed majnún*.

A very graceful tree with drooping branches, very common throughout the Punjab and hills up to 5,000 feet.

The wood is soft, light and even-grained, but has no special use. It makes moderately good fuel. The branches are used for baskets, wattle work, fences, &c., and the protection of canal banks.

It is best propagated by cuttings made from shoots two to four years old. On very wet soil large cuttings 6 or 9 feet long may be used. When irrigated, cuttings should be set out at the end of the cold weather.

This tree grows mostly on very moist soil in the immediate vicinity of rivers and "jhíls." Is very fast growing, but short lived—12 to 16 or 18 years only. Along rivers willow plantations made from cuttings set *direct* in the soil are the very best protection against the washing away of the soil.

WILLOW—BED LEILA.

Salix tetrasperma. (ROX.)

A smaller tree than the weeping willow and the branches do not droop. Found in the same situations, but not so commonly grown.

The wood is much the same as that of *Salix babylonica*, but has been used for making gunpowder, and the leaves are lopped for fodder.

Propagated in exactly the same way as the weeping willow.

PILU.

Salvadora persica. (L.)

A small evergreen tree, grows wild in the southern parts of the Punjab and in Sind. Planted, particularly near Mussalmán tombs, in many parts of the Punjab.

Wood soft, easy to work and takes a good polish and is not attacked by white-ants; it is nevertheless very little used. It is a poor fuel and useless for building. The root bark blisters the skin, and the roots are sold in the bazárs as tooth-cleaners (*miswák*). The shoots and leaves are a favourite fodder for camels. The fruit is bitter, and is used medicinally.

Grows readily from seed which ripens in June in the Punjab (in Sind, January to February).

This tree gives a very dense shade, and when several grow together in a clump the foliage has a remarkably handsome appearance. A good tree for forming groves in the drier districts.

SOAPNUT TREE—RITHA. *Sapindus detergens.* (Roxb.)—A handsome, moderate-sized tree, cultivated on dry spots near villages throughout the lower hills as far west as the Chenab up to 4,000 feet, and cultivated also in Bengal.

The wood is of no value. The valuable product of the tree is the saponaceous pulp of the fruit, which is an article of trade in the Punjab and North-Western Provinces.

Propagated from seed, which ripens after the rains—July onwards—and should be sown in nurseries or pots.

Suitable for cultivation in the lower hills.

ASOKA (in Bombay). *Saraca indica.* (L.)—A handsome dark-foliaged tree with yellow orange flowers, indigenous in the forests of South India and East Bengal; cultivated near Hindu temples and in gardens in most parts of India.

Cultivated for its flowers. When young the leaves droop and are of a deep red colour.

Suitable for cultivation in gardens in the plains.

JAINT, JAINTAR. *Sesbania ægyptiaca.* (Pers.)—A well-known very fast-growing small tree, a native of tropical Africa, but naturalized in India. Grows along the lower hills in the Punjab up to 4,000 feet, and also in the Punjab plains as far as Peshâwar.

In the drier parts of the Deccan it is grown to furnish poles as a substitute for the bamboo and for fuel. Rope is made of the bark, and the leaves and branches furnish cattle fodder.

Readily grown from seed, which can be easily collected in most of the less dry districts.

Very useful as a fast-growing, shade-giving tree near wells, &c., and to form a quick growing hedge. But it is very short lived—10 or 12 years at most. On the rich alluvial banks of the Kistna and warmer rivers of the Deccan which are submerged during the annual floods it is grown from seed as an annual, attaining 15 to 20 feet in one season. In Sattara it is grown with *bakain* and *sohanjna* (*Moringa pterygosperma*) to shade and support the betel vine in thickets 20 feet high. Grown in the plains at Lahore and other places.

GULKANDAR. *Sterculia villosa.* (ROX.)—A good-sized, handsome, broad-leaved tree, with grey bark. Grows wild along the lower hills of the Punjab as high as 3,500 feet, and in the Salt Range.

The inner bark yields a coarse very strong fibre, which is made into ropes and coarse canvas for bags.

Propagated from seed, which ripens in April and May.

There are several other species of *Sterculia*, more or less common in the lower hill forests, which may be propagated in the same manner. *Sterculia fœtida*, the deodár of Western India, is a very stately tree, but is not found in the Punjab. *Sterculia colorata* is common and remarkable for its orange flowers, but is leafless during some part of the year, and is not recommended for cultivation.

S. platanifolia is hardy, but as it is of slow growth, and is not spreading, it is only fit for gardens.

TAMARIND TREE—IMLI. *Tamarindus indica.* (L.)—A well-known, large, handsome, evergreen tree, with high, broad, shady crown, originally a native of tropical Africa, now commonly cultivated all over India, except the north-west and south of Punjab and Sind.

The wood, though extremely hard and difficult to work, is exceedingly prized for many purposes. It is an excellent wood for turning, and the dark coloured heartwood is very durable. The fruit is eaten, and its acid pulp is used as a medicine, and is an article of commerce, very largely used by the natives of India.

Grows freely from seed in almost any soil, but suffers from frost and rarely bears fruit in the climate of the Punjab.

The shade of this tree is scanty, and it is a very slow grower. Although a magnificent and useful tree, it cannot be recommended for cultivation in the Punjab.

TAMARISK—FARASH.

Tamarix articulata. (Vahl.)

A good-sized tree, attaining 60 feet in height in the Punjab, somewhat resembling a pine tree at a distance in the general appearance of its leaves.

Common throughout the Punjab plains from Delhi to Peshâwar and Mooltan.

The wood is whitish, fairly strong and durable; used for agricultural implements. The green wood burns with an offensive odour, but when seasoned is a good fuel without smell. The bark is employed for tanning. The small gall often produced on the branchlets by an insect are used as a mordant in dyeing and tanning.

Propagated most easily from cuttings. The seed, which ripens in January, does not germinate readily as a rule. It is very small, and it is usual to mix it with sand when sowing. Cuttings may be planted in January and February, or in June and July. This is the cheapest method of growing the tree. The cuttings may be planted direct or in irrigated nurseries until rooted. Small

nallahs, one foot deep, two feet apart, are made, and cuttings 18 inches long are planted 12 inches apart on the ridge thrown up between the trenches, the whole being watered regularly.

It prefers a loamy soil, but grows well on saline soils, and is found on hard clay soil and on sand. It is a rapid grower and forms a thick tap-root, and is very hardy. Springs up naturally from seed. The tree, when once established, grows readily, even in the driest districts, if watered for a short time only at starting. The farash coppices freely. The stool, no matter how hacked, always throws out a mass of shoots.

YEW—BARMI. *Taxus baccata.* (L.)—A well-known large tree, with dense dark-green foliage, grows wild throughout the hills at from 5,000 to 10,000 feet; abundant in places, but very local.

The wood takes a beautiful polish. In Europe it is used for turnery, carving and other purposes which require a firm and elastic wood; whip handles are made of the branches, and from time immemorial it has been the principal wood used for bows. The Indian wood, as far as known, has the same qualities, but it is not extensively used. The tree is held in great veneration in some parts of the Himalayas, and the wood is burned as incense in religious festivals. The leaves are used medicinally in the Punjab, and the berries are eaten as a fruit.

Propagated from seed, which ripens about October to November. The seed should be sown as soon as ripe in nursery beds, or in boxes or pots with prepared soil. As the tree is a very slow grower, many years must elapse before the seedlings are tall enough to plant out.

The yew is a highly ornamental tree, well suited for planting out at high elevations, but its slow growth prevents its being very generally used. Trees more than 1,000 years old are known to exist.

BAHERA.

Terminalia bellerica. (ROX.)

A large handsome tree, with a tall straight trunk and broad massive crown. The flowers have a strong offensive smell.

Grows wild in the eastern part of the Siwalik tracts, and occurs planted, attaining a considerable size, as far as the Indus and in the hills north of the Peshâwar Valley, but not found in the arid regions of the South Punjab.

Its yellowish wood is coarse-grained, and subject to the attacks of white-ants and other insects; used in building. The fruit is a favourite food of cattle, and is used in dyeing and tanning, being one kind of the *myrabolans* of commerce. The kernel is sometimes eaten. In Kângra the leaves are considered the best fodder for milch cows.

Propagated by seed, which ripens during the cold season, and should be sown in April and the seedlings planted out during the rains.

This is a fine, handsome tree, but is difficult to rear as an avenue tree. It thrives well in the Lahore gardens.

HARRÂR, HAR. *Terminalia chebula.* (Reth.)—A moderate-sized tree, which grows wild in the Siwalik tract and outer hills up to 5,000 feet; cultivated occasionally in the lower hills at about 2,000 feet.

The wood takes a good polish and is fairly durable, used for furniture, agricultural implements and house building. The dried fruits of this tree are the black *myrabolans* of commerce used medicinally and in dyeing, &c.

Propagated from seed, which ripens January to March.

Grows well in a well-drained, loose soil in the plains districts near the hills or lower hills.

There are very many other species of *Terminalia* found here and there in the Siwalik tract and along the outer hills.

Terminalia arjuna, called "arjan" and "jumla" in vernacular, especially has very graceful foliage, and is occasionally grown in the plains districts and along the lower hills. There are some fine specimens of this tree near Kângra. *Terminalia tomentosa* is also found, but is only suitable for close-binding soils in moist districts. All the Terminalias are worthy of cultivation, but would require a good deal of irrigation in most of the Punjab districts.

ELM—PAPRI. *Ulmus integrifolia.* (ROX.)—A large handsome tree, found occasionally in the Siwaliks and said to be planted about Delhi.

The wood is employed for building and furniture, and much used for fuel and charcoal.

Propagated from seed, which ripens June to August and remains long on the tree.

This is a very fast-growing tree and should be cultivated in the eastern districts of the Province.

ELM. *Ulmus Wallichiana.* (Planch.)—The large-leaved elm, a large handsome deciduous tree, grows wild in the hills from the Indus to Nepal at from 3,500 feet to 10,000 feet.

The wood is used for making water-troughs, water-mills and domestic purposes; extensively lopped and leaves used for fodder. The bark contains a strong fibre, which is made into cordage, sandals and slow matches.

Propagated from seed, which ripens in May and June, and should be sown in well-prepared beds of sand and leaf mould near a stream or water-course. Seedlings require light and will not spring up in shade. Should be planted out during the rains at three or four years old near a water-course or in a moist situation in well-drained soil.

Suitable for cultivation in the hills.

ELM—MANDU. *Ulmus campestris.* (Spach.)—The small-leaved elm; a large shady tree, grows wild in the hills; common near villages.

Wood used for the same purposes as that of the large-leaved elm, but is not much valued. Lopped for fodder.

It is propagated in exactly the same way as the large-leaved species, and should be grown in the same situation as the above.

GRAPE-VINE—DAKH, ANGUR.

Vitis vinifera. (L.)

A large woody climber of a family of which several species are common in Indian forests. Grows wild in Central Europe, Western Asia, and apparently in the hills from 3,000 to 6,000 feet, and is cultivated in temperate climates throughout the world; in Kashmir at from 5,000 to 6,000 feet, and at higher elevations on the Chenab and Sutlej. Grapes of ordinary quality are raised at most places in the Punjab plains, those of Peshâwar being the best.

Raisins are also made, and both raisins and green grapes of good quality are largely imported from Afghânistân. Several attempts have been made to manufacture wine in the Punjab on European principles. Good results have been obtained in Kashmir.

The vine is easily propagated by cuttings of well-ripened wood. These cuttings should be grown in well-prepared nursery beds until rooted, and then planted out during the rains in lines at about eight feet apart in a good loamy soil which has been thoroughly manured, worked up (to 18 inches at least) and drained. Any crop that does not grow high enough to shade the vines may be planted between them—lucerne for instance. The main stem of each vine should be tied up to split stakes set in the ground at a foot from each. The main branches will bear fruit in about three years if the vines are well tended. During the cold weather the ground should be well cultivated and forked, the roots should be opened out and exposed for about 15 days and then the holes filled in with powerful manure; poudrette, decayed sweepings, bones roughly broken with the hammer, offal from slaughter-houses, are all recommended. The vines will require careful pruning during the cold weather, after the fruit has ripened and before the buds form. The useless wood and long trailers should be cut away and the fruit-bearing branches cut back to about three feet in length or three eyes. As soon as the flowers begin to form, and from then until the grapes begin to *set* free, irrigation will be required in the plains. When the bunches are large enough, it will greatly improve the fruit if many of the berries are picked off, so as to give the others room to develop. While the fruit is ripening irrigation should be so much reduced that the leaves turn quite yellow.

Grapes may be grown along a paling or fence, or on low bushes or on trellis work. Grapes grow best in a dry climate and an open friable soil, but it must be very richly and heavily manured. European varieties of the grape thrive

fairly well in India, but do not tend to become established. The best native varieties cultivated are—

Kashmiri or *Waláyati Angúr* (although it comes from Afghánistán).—The long-shaped, hard-skinned kind usually imported in boxes packed in cotton wool.

Black grapes or *Bedána Angúr*, resembling the Kashmiri in shape, but black in colour.

White Mascedene or *Safed Angúr*, the most commonly cultivated.

Black Hamburgh or *Habshi Angúr*.—A dark mahogany deep brown coloured grape.

Ber.

Zizyphus Jujuba. (Lam.)

A thorny moderate-sized tree, common throughout the Punjab, cultivated as a fruit tree near Delhi and other places.

The wood is tough and durable, favourite material for saddle trees, building, Persian wheels, &c.; yields good charcoal and valuable as fuel. The fruits are collected in the hills and dried. The bark is used as a dye stuff; the root is a febrifuge. The leaves are very largely used for fodder, and are very much prized for milch cattle. The lopped branches are very largely used for fencing.

Propagated by seed, which ripens in May and June. On irrigated land the seed should be sown in the rains or as soon as ripe; on sailába land during the rains only. The seed should be sown rather deep and the earth pressed down. It is liable to be scratched up by jackals, but if the fleshy portion of the fruit is removed they will not do so. Where the fruit is eaten, the *stones* may sometimes be collected from the people and are suitable for growing and not liable to be injured. May be sown direct in groves, but it is best to raise the plants in well-irrigated nurseries near wells, and plant out the seedlings towards the end of the cold weather if to be irrigated, or with earth round their roots during the rains.

This is one of the most useful trees in the Province, but one which has been much overlooked in district planting. It may be grown in all portions of the Punjab plains, and with less water than most other kinds. It grows fast, coppices well, gives a dense shade, and its wood, bark, leaves and fruit are exceedingly valuable. A closely allied species, the "*mulla*" (*Zizyphus nummularia*), the leaves of which are much used for fodder, grows in the very driest districts as a small shrub.

The cultivated variety, called "seo ber" or "pewandi ber," is grown in the gardens in Lahore, Amritsar, Delhi, &c. These are grafts on the indigenous tree. The grafting is done as follows:—

In the early part of February or end of the cold weather, an ordinary seedling about three years old is cut down and allowed to throw out coppice shoots or pollarded. The shoots from the *stocks* on which the superior variety it is wished to reproduce is grafted or budded. This is generally done by *ring* grafting. Rings of bark from the shoots of the superior variety it is wished to reproduce are cut about three-fourths of an inch long and fixed on the stocks, taking care that they exactly fit the places prepared for the purpose on the stocks, and the whole bandaged up and covered over with clay in the usual way. Some *málís* graft in this way without any bandage in the cold weather. Only a few shoots are budded; the remaining shoots are pruned down, and care must be taken to keep them down. Treated in this manner, the grafts blossom in October, six or seven months after the operation, and the fruit ripens in the cold weather.

The fruit of the cultivated varieties is very much esteemed by the native population, and, as the tree is very hardy and one of the few adapted to the climate of the drier parts of the Punjab, it deserves attention.

A SHORT CALENDAR OF ARBORICULTURAL OPERATIONS FOR THE PUNJAB.

Plains.

For April, May, and June.

Seeds ripen of kikar, reru, sufedar, dun siris (to be sown at once), mohwa, kachnár, semal, chhichhra, lasúra (to be sown at once), tendu, amlok, jáman (to be sown at once), banyan, fig tree, rumbol (*F. cordifolia*), bat bar (*F. glomerata*), palkhar (*F. infectoria*), pípal, kharpat, kumhar, phalsa, mango, sohánjna, khirni, mulberry (to be sown at once), kemal, sukhchein (to be sown at once), bhan (*Populus euphratica*), jhand, peach, almond (seed imported), pear, *Sterculia villosa*, elm (papri), ber, toon, waláyati kikar.

Spring sowings to be continued. All seeds gathered during the rains and winter months which have not been sown at once should be sown in the nursery beds as early as possible. Direct sowings in *irrigated* ground should also be made.

The irrigation of the sowings and young plants in nursery beds and of the trees along road-sides and in groves should be continued steadily all through the hot weather.

The transplanting to nursery lines of the young plants of the past year growing in the seed beds may be completed. The plants in trenches, if to be planted out during the year, may be allowed to remain in the trenches until they are put out.

The *planting out* of young trees from the nursery may be continued and completed as early as possible.

As the hot weather advances, grass shades must be put up over the sowings in the nursery beds and over delicate young plants.

Towards the end of hot weather, the sowings in the nursery beds and in irrigated ground will require to be weeded. Direct sowings will also require to be weeded wherever the growth is found too heavy.

For July, August, and September.

Seeds ripen of siris, custard apple (to be sown fresh), karaunda, *Catalpa sp.*, darawi (to be sown at once), khark, barna, guláb jáman (to be sown at once), chamun, ním, olive, date-palm (to be sown as soon as procurable), amrút (to be sown at once), pomegranate, banni (*Q. annulata*) (to be sown at once), rítha, asoka, *Guatteria longifolia*.

As soon as the rains break, sowings in unirrigated land and rainy season transplanting operations to be commenced.

The cuttings put into the nursery lines during the preceding months should be planted out if rooted. Cuttings for unirrigated ground, of all species named in the calendar for January to March, to be made.

Mango and other fruit trees are to be inarched where required.

The spring sowings and young plants, both in the nursery and outside, will require to be weeded more than once.

The nursery lines and rainy season sowings will require to be irrigated in all the drier districts.

Sowings to be made in land along rivers liable to inundation during the spring.

For October, November, and December.

Seeds ripen of khair, phulai, ohi, bel, shisham, charbi (tallow tree), wood apple, dhamman, chamba, chíl, kakkar.

The ground for new nurseries should be selected, cleared, and ploughed up as soon after the end of rains as possible.

Delicate young plants and fruit trees should have grass huts built over them as a protection from frost.

The digging of the pits for planting trees along avenues and in groves should be commenced during this season and continued until completed.

Hedges should be pruned and vacancies filled up.

Fellings may be commenced. Coppice-fellings should be postponed until after the season of severe frosts.

For January, February, and March.

Seeds ripen of kamrakh, amaltás, *Dillenia indica*, kendu, loquat, tremul (*F. Roxburghii*), bakain (to be sown at once), amla, kanak champa, jaint, tamarind tree, tamarisk, bahera, harrar, putajan.

The preparation of the nurseries should be continued, the ground being fenced in, thoroughly worked up, manured, and trenched ready for spring sowings.

Fellings and thinnings should be continued until completed.

The pruning of road-side trees, where necessary, should be commenced immediately after December and completed before April commences.

Coppice fellings commenced after frosts should be completed before the end of March, or earlier if possible.

The planting of road-side trees should be commenced as soon as the frosty nights are over. All large trees should be planted out before the cold weather terminates. Broad-leaf trees may also be planted out without earth during this season.

Cuttings may be made of siris, safed siris, semal, bamboo, mulberry, catalpa, shisham, carob, oranges, coral tree, banyan, pípal, and other fig trees, karpat, dhaman, sohánjna, willow, farásh, &c., to be made both for planting in the nursery lines until rooted and where required for direct planting in irrigated land and along rivers.

The fruit trees it is required to reproduce may be layered, grafted, or budded as required.

The irrigation of nurseries and of road-side plants should be commenced.

Hills.

Spring—April, May, and June.

Seeds ripen of krun, chinar, apricot, cherries, plums, pajja (*Prunus puddum*), elms.

The nurseries should be taken in hand early, and the soil loosened about the roots of young plants. The vacant plots in the nurseries should be trenched and prepared for planting.

Pits where required should be dug for planting out along avenues, groves, &c., during the rains.

Most of the evergreen shrubs planted during the previous rainy season will require to be watered.

The grafting of fruit trees may be continued until the 15th April.

Rains—July, August, and September.

Seeds ripen of silver fir (to be sown at once), Himalayan horse chestnut (to be sown at once), Spanish chestnut (to be sown at once), hazel hawthorn (to be sown at once), Mountain ash, walnut tree, bird-cherry (to be sown at once), apple, oaks (*Q. semecarpifolia and Q. dilatata*).

The planting out of seedlings and rooted cuttings should be commenced as soon as the rains have set in.

Cuttings should be made of willows, poplars, bird-cherry, wild pear, quince, wild plum and all other trees which are propagated by this method. These should be planted out in the nursery lines until rooted and ready for transplanting during the following rains, or, in suitable cases, they may be planted out direct where they are to grow.

The seeds of silver oak, silver fir, Himalayan horse chestnut, Spanish chestnut, hawthorn, bird-cherry, &c., which ripen during this season and cannot be kept until the autumn, should be sown in nursery beds or in pots.

Seedlings in the nursery may be transplanted to the lines where necessary, and very young self-sown seedlings of such species as are found in the neighbouring forests may be collected and planted in the nursery lines.

Apple and pear trees should be grafted in July, and apple, pear, peach, apricot, plum and cherry trees should be budded early in August.

The nursery lines will require frequent weeding and cultivation during the whole of the rainy season.

The vacant plots in the nursery are to be trenched during fairly dry weather and prepared for the autumn sowings, which may be commenced at the end of September.

The trees planted during the rains will require to be watered after the rains cease and the surface-soil loosened.

Fellings which, owing to impossibility of working during the winter, it is necessary to make, should be continued.

Winter—October to March.

Seeds ripen of chil-pine, spruce-fir, maples, alder, deodár (to be sown at once), halen (to be sown at once), twisted cypress, blue pine (to be sown at once), wild pear, morus, yew (to be sown at once), *Rhus sp.* (to be sown at once). Rhododendron, grey oak (ban), holly.

The autumn sowings should be continued, and all seeds which have been collected and which it has not been necessary to sow at once should be sown early. (Seeds recommended to be sown at once may, if it is impossible to sow them at the time, be preserved if mixed with moderately dry earth, so as to exclude the air.)

The pots containing plants and in which seed is sown should be buried up to the rim in leaf mould as a protection against frost.

The planting out of trees may be continued and transplanting in the nursery lines until snowfall.

The ground between the young trees in the lines should be covered with leaves or straw early in the season as a protection against frost.

Fruit trees should be pruned at mid-winter.

Scions should be taken for grafting about the 15th January. These scions should be buried to half their length in the ground under required, and the ground above them kept moderately moist. The grafting of fruit tree should be commenced about the 15th March.

PART III.

REMISSIONS OF LAND REVENUE IN CONNECTION WITH ARBORICULTURE.

1. Arboriculture is supervised by the Government direct, not through the Financial Commissioner; but the treatment of remissions of land revenue in connection with arboriculture is controlled by the Financial Commissioner.

A.—Assessment of Gardens and Orchards.

2. During the assessment or re-assessment of an estate, plantations of timber trees and gardens of fruit trees of slow growth, in which ordinary crops are not cultivated, may be excluded from the assessable area, or exempted from assessment for a portion of the term of settlement, or assessed at half the rate of assessment for land with similar advantages not under trees, according to circumstances, subject to the condition that if the land is subsequently brought under ordinary cultivation or cleared of trees it shall be assessed at full rates. In the case of fruit trees, the term of exemption should be fixed with reference to the time which must elapse before the garden becomes profitable. The land for which such favourable terms are given should not exceed ten per cent. of the cultivated area of the estate, or where the shares are held separately, of the share of the estate of which it forms part. Favourable terms need not be given for gardens of fruit trees which come to maturity speedily and yield an early return. But in no case should the rate of assessment for land under timber or fruit trees exceed the village rate for land with similar advantages not under trees.

Circular 34, 1882.
Barkley's Direction to Settlement Officers, paragraph 71.

3. As to these conditions, it must be remembered, *first*, that action under them can only be taken during an assessment or re-assessment; *secondly*, that the conditions themselves do not apply to the compounds and gardens of civil stations for the assessment of which separate orders are given in paragraph 22 and Appendix D. of Financial Commissioner's Circular No. 39 of 1888 on assessments; and, *thirdly*, that in regard to timber plantations greater indulgence is allowed as explained below.

B.—Wayside Groves.

4. The rules regarding the grant of máfis to persons who undertake to sink a well and plant a grove on some main line of road are given in Appendix D.

Circular 34, 1882.

C.—Remission of land revenue on account of injuries to crops caused by the shade of road-side trees.

5. In 1876 the sanction of Government was accorded to a proposal made by Colonel Wacé, Settlement Officer, Jhelum, that the following remissions should be made in that district in favour of cultivated lands adjoining road-sides which might have been successfully planted with trees, *viz.*—

(1) the whole revenue of all unirrigated land,

(2) half the revenue of all irrigated land,

up to a limit of 55 feet (one local chain) from the trunks of the trees, the remission to be liable to resumption by order of the Collector if in his opinion the trees were at any time injured by the will or neglect of the occupants of the land so favoured, or when the trees died or were removed.

Punjab Government No. 159, dated 15th February 1876, to Secretary, Financial Commissioner.

6. The same proposals were shortly afterwards sanctioned by Government for the Hoshiárpur District, with an additional proviso, which is applicable to all districts, that when land, of which the revenue is remitted on account of trees growing thereon, is taken up for repairing roads, it shall not be reckoned as máfi land, and that this stipulation should be made when the remissions are granted.

Punjab Government No. 661, dated 22nd May 1876, to Secretary, Financial Commissioner.

7. A similar remission was granted in Ludhiána in November 1882, and the Financial Commissioner was at the same time authorized to grant remissions of the same kind in any other district in which they might be required, reporting in each case for the information of Government.

D.—Timber Plantation.

8. On this subject orders of the Government of India have been issued, on which the instructions in this paragraph are founded.

Circular 34, 1882.

Subject to the above Rules (A) regarding fruit trees, all revenue-paying land planted with timber-producing trees may be freed from assessment, either by the Settlement Officer at a general revision of assessment or by the Collector at any other time. If the Settlement Officer exempts land from assessment under these orders, he will treat the land like a *máfi* or revenue-free plot, and record in the settlement *misl* the assessment remitted and the term and conditions of remission.

If a Collector proposes to free land from assessment under these rules he will submit an application in the form appended, Appendix E, for the orders of Government, and several cases may be included in the same application. The following rules are prescribed for the guidance of officers in dealing with this subject:—

I.—The exemption may be for the whole term of settlement, or for 12 years if the settlement expires before 12 years from the date of exemption.

II.—The trees must be planted, not self-sown.

III.—The plantation must be sufficiently thick to render the land which it covers unfit for cultivation.

If this condition is at any time not fulfilled, the assessment will be reimposed at the rate fixed at settlement for the land.

IV.—With the consent of the Collector, land which has been freed from assessment under these rules may be cleared of trees and replanted, without becoming liable to assessment under the previous rule, provided it is at once replanted.

V.—In the case of land assessed to Government revenue which shall hereafter be planted with timber trees, no exemption shall be allowed unless the sanction of the Collector shall have been obtained to the formation of the timber plantation.

VI.—Collectors and Settlement Officers are responsible that not more than 10 per cent. of the cultivated area of any estate, or (when the shares are held separately) of the share of the estate, of which the plantation forms part, is exempted from assessment under the operation of these rules.

VII.—At the expiration of the period of exemption fixed by the Settlement Officer or Collector, or when the exemption becomes resumable owing to non-fulfilment of the conditions on which it was allowed, the Collector will impose the assessment remitted at settlement or after settlement, reporting that he has done so in the manner prescribed for reporting lapses of revenue-free assignments.

VIII.—A Mauzawár Register of such exemptions should be kept up in each District Office in the form subjoined (Appendix F).

9. The Punjab Government has sanctioned, in a letter No. 839 of 10th July 1876, the remission of assessment on land planted with the Chinese mulberry (*Morus sinensis*) on the same conditions as are applicable to land planted with timber trees. Deputy Commissioners of districts where this tree

can be grown with success, and where silk culture is carried on, or is practicable, should take every opportunity of making known to the people the orders on the subject and of encouraging applications for such remissions, which must be reported for sanction.

10. The Punjab Government has allowed the grant of specially favourable conditions in the way of remission of land revenue to proprietors who plant groves on or near the banks of "chos" or hill torrent.

The conditions were as follows. All village proprietors planting with timber trees (other than fruit trees), on or near the bank of a "cho" on a spot approved by the Collector with reference to the object of resisting the encroachments of the "cho" or sand drifts, an area of banjar land not less than one acre were to be entitled for the term of settlement to a remission of land revenue on their assessed lands, at a rate per acre planted equal to 1½ times the incidence of the total village assessment per acre of total area.

Punjab Government No. 643, dated 14th June 1881, to Secretary to Financial Commissioner.

In the case of cultivated land the Punjab Government thought it would ordinarily be sufficient to grant the remission at the village rate above mentioned, but discretion was left with the Financial Commissioner to sanction remission in this case also at 1½ times the rate mentioned, if desirable.

The planting was to be properly kept up, and trees were not to be cut down until they should have attained a good size, and in case of a tree dying or being cut down, a new one was to be planted in its place. The plantations were to be regarded as the exclusive property of the village proprietors, and not of Government.

These conditions were to be entered in the village administration papers, subject, in regard to the planting of shámilát lands, to the consent of the majority of the proprietors.

11. Sanction has also been given to the insertion, at the settlement of any district, of a clause in the administration paper allowing the appropriation for tree planting of part of the common land of a village. The form of the clause and the conditions inserted in it would vary with the requirements of each district. It might, *e.g.*, give the lambardar, with the consent of the majority of the khewatdárs, a right to plant at any time trees in, say, one-tenth of waste shámilát, and to prevent grazing after planting, till the trees are safe from injury, &c. Its inclusion in the administration paper would be contingent, as a matter of course, on the free consent of the village proprietors.

PART IV.

INSTRUCTIONS FOR THE PREPARATION OF TRIENNIAL REPORTS AND ANNUAL STATEMENTS.

1. The orders regarding the submission of Arboriculture Reports which have been issued by the Punjab Government and approved by the Government of India require that these reports shall be submitted triennially. In intermediate years statements only need be prepared, no further commentary on such statements being required than what may be recorded in the column for remarks. In the following extract from the records of the Punjab Government the considerations which have influenced Government in adopting this system are set forth :—

> The Lieutenant-Governor has long been impressed with the necessity of relieving local officers to some extent of the great burden of reports and returns which is now thrown upon them, and he desires to take the present opportunity to address the Government of India in the Revenue Department regarding the submission of Annual Arboriculture Reports. Of all subjects on which reports are submitted by local officers the subject of arboriculture in the Punjab appears to Sir Charles Aitchison to be the least suited for annual treatment. Owing to climatic and other causes, a very large number of the young plants which are put out in road-side avenues invariably succumb during the first two years, and in a season of drought many established trees also perish, as may be seen from the present report. The annual treatment of a subject almost invariably leads to indifference on the part of the writer, as far as the experience of the Lieutenant-Governor goes, and in the present case the results which are treated year by year are misleading when dealt with in this way. His Honor is sure that if the report were submitted once in three years, local officers would bestow much more interest on its preparation than they can be expected to do now, and that the results recorded would be far more valuable in every respect than at present. He would therefore propose that reports on the progress of arboriculture should be submitted triennially, and that for other years statements should be prepared accompanied by the briefest possible notes in a column of remarks.

The first triennial report was submitted in the year 1887 for the three years 1884—1887. Reports will accordingly be due in the years 1890, 1893, 1896, and so on.

2. The triennial reports and annual statements relate to the financial year ending 31st March. They should be submitted to the Commissioners of Divisions before the 15th of June and should reach the office of the Conservator of Forests by the 1st of July. The reports of officers of the Public Works Department should reach the Conservator by the same date. The Provincial Report will be compiled by the Conservator of Forests and should reach Government by the 1st of September. The reports have been submitted very late in many cases in the past, and special efforts should be made to ensure their punctual submission in future.

3. The annual statements which are now prescribed for adoption have been slightly modified from those recommended by the Special Arboriculture Committee which assembled in 1886. These statements are given in Appendix G. Instructions for filling up the several columns are given in the notes printed at the foot of each return, but it is desirable to make a few general remarks on the subject, as great want of care has been observable in the preparation of arboricultural returns in the past. In the Review of the Triennial Arboriculture Report for years 1884-85 to 1886-87 it was directed that in future lengths of roads should be shown in miles and decimals of miles. This direction, which was in accordance with the recommendations of the Arboriculture Committee, was, however, neglected in the returns for the year 1887-88, in which the old practice of showing lengths in feet was continued. It should be distinctly understood that for the future all lengths are to be shown in miles and decimals of miles, and that areas are to be exhibited in acres and decimals of acres, all mention of roods and poles being avoided. In determining the English equivalent of local measures of length or surface, the Circular of the Financial Commissioner, No. 20 of 1888, should be consulted.

4. Again, in the case of returns of rainfall, the statements submitted in past years have been conspicuous for their inaccuracy. Thus in the return for the year 1887-88 the rainfall during the year in Ferozepore was given as 50·91 inches and the average rainfall 4·24 inches. The average rainfall according to the corresponding return of the previous year was 22 inches. In Karnál the average rainfall was given as 3·76 inches in 1887-88, and in the previous year as 29 inches. It is not expected that all tabular statements should be checked figure by figure by superior officers; but so much supervision on the part of these is looked for by Government as will ensure that errors so palpable as those instanced above shall not appear in the returns which are submitted to Government. There is perhaps less justification for such entries in this arboricultural return than in any other, because, as now explained in the foot-note to the return, the necessary data can be taken without any trouble from the register of rainfall prescribed by the Financial Commissioner's Circular No. 62 of 1886.

5. Regarding Statements Nos. II to V, the points to which the attention of the officers concerned should be directed are the following:—

(1) Quantities (areas or lengths) brought forward as existing at the beginning of the year under report should invariably correspond exactly for each district, canal, &c., with the balance shown in the last *printed* report as remaining at the close of the previous year. Should the closing balance of the previous year have been erroneous, the opening balance should nevertheless correspond with it, the error being corrected by an entry under the appropriate column for failures or additions, with an explanatory note in the column of remarks.

(2) The closing balance in these statements, showing areas or lengths stocked at the end of the year, will be the opening balance, *minus* or *plus* the net result of the additions or failures of the year. These additions or failures will be the actual results of arboricultural operations during the year; but, as above explained, additional entries will be made to correct errors of compilation measurement or printing which may have occurred in previous returns.

(3) Returns submitted by Deputy Commissioners should be for the district as a whole, and need not include details for each tahsíl. Such details should, however, be recorded in the registers kept at the District Office.

(4) In years for which returns only are forwarded a concise note generalizing the results obtained during the year for the district, &c., *as a whole*, should be entered in the remark column of all the returns. This note might refer, for example, to the meteorological conditions prevailing during the year and to any other matters of importance which bear on the particular work or return in question.

All large variations and unusual results should also be here explained.

(5) Where any afforestation operations are in progress, as in the Delhi and Gurgaon Districts, entries regarding these should be made in Statement III and should be explained in the column of remarks of that statement.

6. Should any doubt arise as to the manner in which a return should be compiled, the compiling officer should ask the Conservator for advice on the question.

7. During the compilation of the Provincial Report or Statements, the Conservator will refer by docket direct to the officers concerned regarding any matter which in his opinion needs elucidation or correction; and such officers will dispose of these references as speedily as possible.

8. All arboricultural operations undertaken by Municipalities should be shown in the return for the district concerned, but should be entered separately, and any special arboricultural works undertaken by Municipalities should be noticed in the general note or triennial report of the district.

9. In compiling the district statements and reports the Conservator will arrange the districts according to the following classification :—

Arid.	Very dry.	Dry.	Forest.
Muzaffargarh.	Ferozepore.	Jhelum.	Gujrát.
Mooltan.	Pesháwar.	Gujránwála.	Gurdáspur.
Dera Gházi Khan.	Kohát.	Gurgaon.	Umballa.
Dera Ismail Khan.	Rohtak.	Amritsar.	Siálkot.
Montgomery.	Lahore.	Delhi.	Hoshiárpur.
Jhang.	Karnál.	Jullundur.	Simla.
Bannu.		Ludhiána.	Hazára.
Shahpur.		Ráwalpindi.	Kángra.
Hissar.			

10. The statements submitted every third year with the triennial report should include the figures for each year of the triennial period and not only those of the third year. The figures of the first two years can be taken from the annual statements for those years previously submitted. The only modification in the form of the annual statements which it will be necessary to make for the purpose of such triennial statements will be the addition of a subsidiary column headed "Year" between columns 1 and 2 of each annual statement. Thus in the triennial statements there will be three rows of entries opposite each district instead of one.

11. Attention is directed to the following paragraph of the Lieutenant-Governor's Review of the Triennial Report submitted in 1887, and it should be understood that a map of the district is required to accompany every Triennial Arboriculture Report in future :—

With the present report Mr. Maconachie has submitted a map of the Gurgaon District showing the extent to which the roads in the district have been stocked with trees, old and new growth being indicated by different colours. The Lieutenant-Governor would be glad to see a similar map of each district in the Province submitted with the next triennial report. The symbols and references to be used in the map should be arranged by the Conservator and should be the same for each district. The ordinary skeleton maps which have been prepared for all districts will no doubt be found suitable for illustrating arboriculture as well as other reports. Such a map would indicate at a glance the extent of the progress made up to date in tree-growing on avenues in each district, and it would be convenient if the localities of nurseries and groves were also indicated upon it.

The maps which should be used are the 8-inch to the mile skeleton maps prepared by the Survey of India. Copies of these have been supplied to Deputy Commissioners by the Director of Land Records and Agriculture, and a copy of a district map with arboricultural entries on it will be supplied by the Conservator to each Deputy Commissioner as a model. The maps which are received with the triennial reports will be returned to each district for record. For exhibiting the progress of arboriculture on roads and canals, maps, even of small scale, are peculiarly well adapted, and they are specially recommended as providing a means whereby tabulated returns can easily be checked by supervising officers.

12. It is unnecessary to specify the numerous subjects which should receive attention in the triennial reports. In each district there will doubtless be some special feature deserving of particular notice. In all districts, however, the results shown in the returns should be carefully but briefly discussed, and in addition to the arboricultural operations carried out by Government officers and Local Bodies, the work done by private persons and village communities should also be summarily noticed. A branch of the subject which it is desired by Government should receive special notice in triennial reports is the cultivation of fruit trees and their distribution among villagers. Special instructions regarding the culture of fruit trees are given in the technical portion of this manual.

APPENDIX A.

SAMPLE PLAN OF ARBORICULTURAL OPERATIONS FOR THE DUSTYPUR DISTRICT FOR THE FIVE YEARS 1886—1890.

Chunián Tahsíl.

With an annual allotment of Rs. 6,000.

I. NURSERIES.—The existing nurseries at Chunián, Pidh, Chor, Kála-ke-Sarai and Dadua are to be replenished with sowings of sissoo, mulberry, terminalia, túp, mango and fruit trees for distribution. New nurseries will be established as follows :—

Situation.	Nature of Work.	Cost.	Remarks.
	1886.	Rs.	
In Plot No. 2 ...	Five malís maintaining and replenishing existing nurseries ...	360	
	One new nursery in common land, Plot No. 2, 1½ acres in extent, to be sown with sissoo, mulberry and tún, with a portion set aside for fruit and ornamental trees; working up the soil to 18" in depth and preparing seed-beds.	120	
	Cost of 2½ maunds of seed and sowing ...	20	
	Watering and care of nursery, two men ...	132	
	Fencing with ditch and bank topped with thorns ...	50	
		322	
On Lonyan Road, between Pidh and Chor.	One new nursery midway, between Pidh and Chor, of one acre in extent, estimated as above.	214	
	Add cost of katcha well, with Persian wheel and other gear ...	60	
	Watering for six months, February to June and September ...	150	
		424	
	Total ...	1,106	1886.
	1887.		
	Maintenance and watering of seven existing nurseries ...	504	
On Lonyan Road, midway between Chor and Phália.	One new nursery, of one acre, precisely similar to the one established between Chor and Pidh.	424	
On Lahore Road, at its inter-section with Jalori Khal.	Three acres, old cultivation, to be sown with species as above. Rent of land.	18	
	Ploughing and preparing seed-beds ...	36	
	Cost of water from Jalori Khal ...	13	
	Two malís and one coolie ...	204	
		271	
	Total ...	1,199	1887.

Note.—Similarly for the years 1888-89 and 1890.

II. PLANTATIONS.—In this tahsíl it is proposed to undertake under the head "Plantations"—

A. Maintenance of existing plantations of XY.

B. A portion of the plot of 500 acres situated near Chunián village, known as Chuniánwála, recently acquired by the District Board. During the period of this plan it is calculated that, by making a katcha well each year, and so gradually extending operations by the acreage irrigable by one well, 250 acres will be completed at the end of five years.

C. The plots numbered 1, 2, 3, 4 on accompanying sketch map or tracing comprising, respectively, 100, 150, 50 and 100 acres, and made over for plantation purposes by the villages of Jelálpur, Kála, Lena and Paji on condition that the management should be under the District Board, who will bear all cost of planting, protection, maintenance, &c., and hand over half of the income that may at any time be realized to the proprietary villages.

D. The planting of 1,000 acres of the Mirza Beg Bir acquired by purchase by the system of annual cultivation leases and sowing in plough lines; the yearly allotments being given conterminously.

Table of plantations of the.....Tahsíl with estimated cost of work.

1886—1890.

Name or designation of plantation.	Nature of Work.	Cost.	Remarks.
	1886.	Rs.	
Plantation X ...	Repair of fencing ...	50	
	Cost of protective establishment ...	72	
		122	
Plantation Y ...	Cost of protection—		
	Two men @ Rs. 6 per mensem, one @ Rs. 5 per mensem ...	204	
	Sowing over 5 acres blanks ...	50	
		254	
Chuniánwála ...	Fifty acres trenched at intervals of 10 feet and sown with sissoo ...	500	
	One katcha well, 10 to 15 feet deep, and well-gear ...	60	
	Hire of bullocks for six months, April to September ...	300	
	Pay of two men @ Rs. 11 a month ...	132	
	Enclosing along boundary with ditch 4′ × 2½′ and bank ¾ of a mile in length, topped with thorns.	100	
	Temporary thorn fence on other sides ...	50	
		1,142	
Village common lands, Plot I ...	Trenching and sowing 20 acres, at 10 feet intervals, with sissoo to be thoroughly watered once in April from tail of——canal.	200	
	Cost of water ...	25	
	Fencing, protection, including one man ...	100	
	Total ...	325	
Plot 3 ...	Trenching and sowing 50 acres with kikar or Jhand on lines at 10 feet intervals.	500	
	Mali and protection ...	100	
		600	
Mirza Beg Bir ...	Sowing, on plough lines, 200 acres leased for cultivation, cost of seed, &c.	300	
	Total ...	2,743	1886.

PLANTATIONS—(*concluded*).

Name or designation of plantation.	Nature of Work.	Cost.	Remarks.
	1887.	Rs.	
Chuniánwála ...	Treatment of an additional area of 50 acres as during 1886 ...	1,142	
	Maintenance and repairs by filling up blanks in nursery of 50 acres previously treated.	50	
	Hire of bullocks for six months. April to September ...	300	
		1,492	
Plot 1 ...	Trenching and sowing similarly 20 acres, watering, fencing, &c. ...	325	
	Water and repairs of blanks in previously stocked area ...	50	
		375	
Plot 2 ...	Transplanting out from nurseries at intervals of 9'×4' 36,300 mulberry sissoo and tún plants, thus covering 30 acres.	240	
	Water from canal cut during April and May ...	45	
	Fencing with thorn fence only ...	20	
		305	
Plot 3 ...	Rapairs to sowings, mali and protection ...	100	
Mirza Beg Bir ...	Sowing a further area of 200 acres on plough lines ...	300	
	Total	2,572	1887.
	And similarly for the remaining 3 years, 1888, 1889 and 1890		

III. GROVES.—During the five years it is proposed to maintain the two existing groves on the Lòyan road and to plant two new groves at Phalia and Kharián encamping-grounds; a grove round the hospital at Chunián, and three groves at suitable places at 8 to 12 miles intervals along the Háfizabad road.

Name or designation of grove.	Nature of Work.	Cost.	Remarks.
	1886.	Rs.	
	Repairing ditch and bank around two existing groves, and filling up gaps in the live fence.	50	
	Watering in April, May and June ...	36	
		86	
	Planting out from Chunián nursery 50 sissoo trees round Hospital.	4	
	Ditch and gabion round each ...	25	
		29	
	Planting one acre at Kála-ke-Sarai with 110 trees, 20 feet apart, mango and pipal.	10	
	Cost of 280 yards wire fencing and setting up ...	120	
	Watering—April, May and June, and again in September ...	20	
		150	
	Total ...	265	1886.
	1887.		
	Watering two groves on Lonyan and one on Háfizabad road, April, May and June.	45	
	Planting out one acre of grove with 110 trees at Dadua, shishum and mulberry.	10	
	Wire fencing as per Kála-ke-Sarai grove ...	120	
	Watering—April, May, June and September ...	20	
		150	
	Total ...	195	1887.

Note.—Similarly for the years 1888, 1889 and 1890.

AVENUES.—The Kusháb Canal is already lined with a double avenue of trees varying from 5 to 15 years, and nothing remains to be done. The Sultánpur road, from Chunián to where it cuts the canal, is also lined with a complete avenue, but the trees require some pruning, as in cases they obstruct traffic, and spread unnecessarily over adjacent cultivation.

Along the Lonyan road trees have been put out over about 16 miles, or six miles beyond Chor. Some 50 per cent. of the plants have either died or been destroyed, and the protective gabions are in bad repair. It is proposed, during the next five years, to carry out the necessary repairs to this avenue, and to extend it as far as Kharián. The pruning of the Sultánpur road avenue will be attended to, and a new avenue will be planted from the canal to the eastern boundary of the tahsíl. It is also proposed to plant avenues along the Lahore road as far as Paji, and along the Háfizabad road as far as Kala ke Sarai and a single line of trees along the northern bank and foot-path of the Sultánpur Khal.

Locality.	Nature of Work.	Cost.	Remarks.
		Rs.	
	1886.		
	Pruning trees along 5 miles of the Sultánpur road ...	50	
	Planting 1,000 trees in gaps of avenue along Lonyan road from nurseries at Chor and Pidh.	50	
	One thousand new wicker gabions @ 8 annas each ...	500	
	Repairing 2,000 old gabions ...	100	
	Watering and protection, eight men @ Rs. 5 for six months ...	240	
	One thousand gharras, and fixing the same ...	65	
		955	
	Planting one mile of new avenue along Lahore road with sissoo, ficus, mulberry, tún, and terminalia from Chunián nursery.	20	
	Protection with ditch and perforated mud wall ...	175	
	Three hundred and fifty gharras, and burying the same ...	20	
	Watering—April, May, June and September, and protection for rest of year.	60	
		275	
	Two miles of trenching along Sultánpur Khal, trench 1′ × 1′ ...	20	
	Sowing ridge with shisham and kikar ...	5	
	Two miles of thorn fencing on one side ...	50	
		75	
	Total ...	1,355	1886

AVENUES—(*concluded*).

Locality.	Nature of Work.	Cost.	Remarks.
	1887.	Rs.	
	Planting 1,000 trees in gaps of the Lonyan road avenue ...	50	
	One thousand new wicker gabions @ 8 annas each ...	500	
	Repairing 1,000 old gabions ...	50	
	Watering and protection, eight men @ Rs. 5 each for six months.	240	
	One thousand gharras, with fixing ...	60	
		900	
	Planting another mile of avenue along Lahore road, as during previous year.	275	
	Watering and protection and repairs of one mile planted during previous year.	80	
	Repairs to mud walls constructed during previous year ...	20	
		375	
	An additional two miles of trenching and sowing along Sultánpur Khal.	75	
	Repairs to old fence ...	15	
		90	
	Planting one mile of new avenue along Háfizabad road in the same way as Lahore road.	275	
	Total ...	1,640	1887

Supervising establishment.

		Rs.
One Darogha in charge of operations @ Rs. 25 per mensem	...	300
Two Guards @ Rs. 6 each	...	144
Travelling allowance of Darogha	...	84
Total	...	528

Abstract of estimated expenditure for the five years, 1886 *to* 1890.

Year.	Nurseries.	Plantations.	Groves.	Avenues.	Establishment.	Total.	Remarks.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	
1886 ...	1,106	2,743	265	1,355	528	5,997	
887 ...	1,199	2,572	195	1,640	528	6,134	

APPEN

FORM OF CON

Record of Arboricultural Operations

Year in which to be carried out.	Provisions of Plan of Operations. Description of Work.	Cost.	Result of Operations. Description of Work.	Cost.	Date of inspection.
	1886.	Rs.		Rs.	
	5 nurseries to be maintained and replenished	360	Carried out	300	...
	Formation of nursery 1½ acres in plot II	322	Nursery formed, 1¼ acres only; fenced with ditch, &c. ...	325	
	New nursery on Lonyan road ...	424	Made	410	
	Maintenance of plantation X ...	122	Fence not repaired, otherwise properly maintained	72	
	Dò. Do. Y ...	254	Maintained	250	
	50 acres, Chunianwála, to be sown with shisham and enclosed	1,142	30 acres only sown, watered and fenced	920	...
	20 acres, plot I, to be sown and enclosed	325	20 acres sown and fenced ...	332	
	50 acres, plot III, to be sown with kikar	600	45 acres only sown	530	...
	200 acres, Mirza Beg Bir, to be sown	300	200 acres ploughed up and sown ...	284	
1886.	Maintaining and watering 2 groves on Lonyan road ...	86	Properly maintained and gaps in fence filled up	91	...
	Planting 50 shisham trees round hospital at Chunián ...	29	50 trees planted and fenced ...	25	
	Planting, one acre at Kala ke Sarai	150	1 acre planted and enclosed with fine fence; watered April and May	130	
	Pruning trees along 5 miles of Sultánpur road	50	Pruning done	45	
	Planting 1,000 trees in avenue along Lonyan road	955	920 trees planted and fenced; 953 new wicker gabions erected, and 2,030 old ones repaired. 920 gharras buried, and trees regularly watered from February to June and in September	1,003	...
	Planting a mile of avenue along Lahore road	275			
	Sowing 2 miles of Sultánpur Khal bank	75			
	1887.				
	¼ acre nursery in plot II ...	54	1 mile planted; gharra buried near each tree, and every plant fenced with mud wall	270	
	Fence round plantation X to be repaired	50	2 miles sown and fenced ...	79	
	20 acres Chunianwála to be sown with shisham and fenced ...	222	¼ acre sown	49	
	5 acres plot III to be sown with kikar	70	Fence round plantation repaired	53	
	80 trees to be planted along Lonyan road and fenced, and gharras buried near roots ...	14	20 acres sown and fenced ...	217	
	Maintenance of 7 existing nurseries	504	5 acres sown with kikar ...	77	
1887.	One new nursery on Lonyan road, between Chor and Phalián ...	424	80 trees planted and fenced, and a gharra buried near each ...	15	
	3 acres to be sown at intersection of Lahore road with Jalori Khal	271	Nurseries properly maintained ...	521	
	50 acres Chuniánwála plantation to be sown, irrigated from a new kacha well, and fenced ..	1,142	New nursery formed	398	
	30 acres sown in 1886 to be repaired and blanks filled up ...	50	3¼ acres sown	280	
	Hire of bullocks for 6 months ...	300	50 acres sown; new well made; fence constructed	1,090	
			Blanks filled up	65	
			Bullocks employed for 6 months ...	300	

&c., &c., &c., for remainder of 1887 in accordance with Plan of Operations.

DIX B.

TROL BOOK.

in the Chunián Tahsíl.

Blank sheet for entry of remarks by Inspecting Officer, and note of any observations and suggestions bearing on the work, with date of entry.

The Chunián nursery should be extended by another acre, to meet demands for seedlings by zamíndárs. The nursery at Kala ke Sarai shows signs of insufficient irrigation—and the nursery at Dadua is much in want of weeding. The Eucalyptus seed sown in January has only partially germinated, and of the species selected *E. Globulus* and *Viminalis* are unsuited to the locality. *E. Citriodora* and *Resinifera* might be tried, if plants are still wanted for the ornamental garden at Chunián.

The whole area of 30 acres is thoroughly stocked with vigorous seedlings, with exception of a patch of about 3 acres near the centre, where the soil is bad and covered with a saline efflorescence. This plot should be planted with the "salt bush."
Large numbers of the seedlings have been killed by frost, and the blanks should be filled up by fresh sowings in the spring of 1887.

Some of the trees have been very injudiciously and badly lopped.

The branches have not been cut off close to the trunk, and the pruning has been done during April and early part of May, instead of the winter. The jagged stumps of the branches should be removed next November.

Many of the plants have been put too deep into the soil, and in some cases they have been insufficiently watered.

APPENDIX C.

Scale of Rewards sanctioned for the Amritsar District by the District Board.

To Zaildars, by whose interest the best results were attained—

1st year, a khushnúdi parwána from Deputy Commissioner.

2nd year, a dopatta and a parwána from Deputy Commissioner.

3rd year, money reward ranging from 20 to 50 rupees.

6th year, money reward and a parwána signed by the Commissioner.

To Village Communities—

Rs. 75 for a grove of not less than 2,000 timber trees of five years' growth.

„ 100 ditto 2,000 timber and fruit trees growth.

„ 40 ditto 1,000 timber trees of five years' growth.

„ 50 ditto 1,000 timber and fruit trees of five years' growth.

To Individuals—

Any person planting a plot of land one bigah in area with timber and fruit trees, or only timber, shall receive—

1st year	Rs. 6	Trees to be planted not less than 30 feet apart.
2nd „	„ 5	
4th „	„ 3	
6th „	„ 2	

For plots less than one bigah, but not less than half a bigah—

1st year	... ...	Rs. 3	0 0
2nd „	... ...	„ 2	8 0
4th „	... ...	„ 1	8 0
6th „	... ...	„ 1	0 0

For avenues of not less than 100 trees the same rewards as for a bigah.

APPENDIX D.

Rules for Grant of Mafis for Wayside Groves.

Barkley's Directions to Settlement Officers, Appendix III.
Grants for wells and groves.
Board of Administration's Circular No. 15 of 1852; Government of India No. 218, dated 13th February 1852, paragraph 5.

1. Revenue-free grants of uncultivated ground, of sufficient extent to employ one pair of bullocks in watering trees, may be made to persons who will undertake to sink a well and plant a grove on one of the main lines of road, to be held so long as the land continues under plantation. The same sanction is required for these as for other grants in perpetuity, provided that such grants shall be at intervals of not less than two miles apart.

2. Where a grant of sufficient extent to employ one pair of bullocks is not a sufficient inducement, a larger grant may be recommended, conditional upon a substantial well being constructed and kept in repair, and on the maintenance of a grove of specified area. In the terms proposed the facility or difficulty of sinking a well and of rearing trees in the locality should be kept in view.

3. Where waste lands are not available in suitable positions along the sides of main roads, grants of cultivated lands, for the purpose of sinking wells and planting groves in localities where they are deemed necessary, may be proposed, the reasons for proposing such grant being explained.

4. The site of the proposed grant must be at a distance of at least two miles from the nearest existing road-side well and grove.

5. Any new grove that may be planted must cover not less than two acres of land, and the grant will be resumable if a grove of this extent be not kept up and the well maintained in repair.

6. The annual value of the grant must not be more than 6 per cent. upon the estimated cost of completing the well and grove, and it must in no case exceed Rs. 30.

7. It is always a condition of such grants, whether of cultivated or of uncultivated land, that travellers should be allowed the use of the grove and of water from the well.

8. Applications for such grants should be in the following form, and several cases may be included in the same application :—

Statement of Proposed Revenue-free Grants for Road-side Wells and Groves in _____ District.

Number.	Name of person who undertakes to form the well and grove.	Distance of nearest existing road-side well and grove.	Village and tahsil in which the land is situate, and name of high road on which the grove will be formed.	Nature of proposed work, area to be planted with a grove, and capital expended or to be expended on the work.	Land proposed to be given revenue free.			Remarks. (The arrangements made by the applicant with the proprietors of the land, when they do not themselves form the well and grove, should be stated; and if cultivated land is proposed to be given, it should be distinctly stated that uncultivated land is not available.)
					Extent.	Annual Revenue.		
						Rs.	A. P.	

109243

APPENDIX E.

Form of Application for Revenue-free Grant of Land assessed to Land Revenue for Timber Plantation.

1	2	3	4	5			6	7	8	9	10	11
No. in Register.	Name of person who undertakes to form a timber plantation.	Village and Tahsil in which the land is situated.	Description of trees to be planted.	LAND PROPOSED TO BE GRANTED REVENUE-FREE.			Extent of land previously released from assessment on account of timber plantations in the same estate or share of estate.	Term for which the exemption is proposed	Opinion of Collector.	Opinion of Commissioner.	Opinion of Financial Commissioner.	Orders of Government.
				Extent.	Jama. Rs. A. P.							

N. B.—A statement for reduction of rent-roll should accompany this application.

COLLECTOR'S OFFICE :

The ——— 18 .

Collector.

APPENDIX F.

Mauzawár Register of Revenue-free Grants for Formation of Timber Plantation in Village ———

1	2	3	4	5	6	7
No.	Name of proprietor.	Area of grant.	No. and date of Government order confirming the grant.	Term for which the exemption is to continue.	Remarks, including date of last inspection.	Date of resumption owing to non-fulfilment of condition or expiry of term of grant.

COLLECTOR'S OFFICE :

The ——— 18 .

Collector.

APPENDIX G.

Forms of Annual Statements.

No. I.

Rainfall Return.

District.	Average Rainfall of past years.			Rainfall of year under report.			Remarks.
	1st April to 30th September.	1st October to 31st March.	Total.	1st April to 30th September.	1st October to 31st March.	Total.	

Notes.

(*a*). The entries should relate to Sadr stations only.

(*b*). The figures should be taken from the registers of rainfall prescribed by Financial Commissioner's Circular No. 62 of 1886 and should agree with those shown in the Agricultural Prospect Reports for the months of September and March (*vide* Financial Commissioner's Circular No. 53 of 1886) which are usually published in the *Punjab Gazette* some time in October and April respectively.

No. II.

Progress Statement of Nurseries for the year

1	2	3	4	5	6
District.	Area under nurseries at beginning of the year.	Area added during the year.	Area given up or transferred to groves during the year.	Area remaining at end of the year.	Remarks.
	Acres and decimals.	Acres and decimals.	Acres and decimals.	Acres and decimals.	

Notes.

(*a*). A nursery is a piece of land set apart for the rearing and tending of young trees for transplantation elsewhere. Where seedlings are not transplanted, but are left to grow up *in situ*, the plot should no longer be classed as a nursery, but as a grove.

(*b*). Column 2 should correspond with column 5 of the previous year's return. If the figures of column 5 of the previous year have been found to be erroneous, they should nevertheless be repeated in column 2, leaving errors to be adjusted by entries in columns 3 or 4. When errors have to be adjusted in this way, explanation should be recorded in the column for remarks.

(*c*). The figures in column 5 should be equal to the total of the figures in columns 2 and 3 less those in column 4.

No. III.

Progress Statement of Plantations for the year

1	2	3	4	5	6	7
District.	Area taken up for plantation at the beginning of the year.	Area successfully stocked at beginning of year.	Area sown or planted during the year.	Area of failures during the year.	Area stocked at end of the year.	Remarks.
	Acres and decimals.	Acres and decimals.	Acres and decimals.	Acres and decimals.	Acres and decimals.	

Notes.

(*a*). A plantation is an area planted with trees with the intention of producing a timber crop, without reference to the development of particular trees. Plantations include areas treated with a view to afforestation.

(*b*). Column 3 should correspond with column 6 of the previous year. If the figures in column 6 of the previous year have been found to be erroneous, they should nevertheless be repeated in column 3, leaving errors to be adjusted by entries in columns 4 or 5. When errors have to be adjusted in this way, explanation should be recorded in the column for remarks.

(*c*). The figures in column 6 should be equal to the total of the figures in columns 3 and 4 less those in column 5.

No. IV.

Progress Statement of Groves for the year

1	2	3	4	5	6
District.	Area of groves at the beginning of the year.	Area planted or transferred from nurseries during the year.	Area of failures during the year.	Area stocked with trees or plants alive at end of the year.	Remarks.
	Acres and decimals.	Acres and decimals.	Acres and decimals.	Acres and decimals.	

Notes.

(*a*). A grove is a group of trees grown for ornament or shade with special reference to the development of individual trees. Nurseries where trees have become too old for transplanting should be transferred to groves. Under this designation are included *topes* of trees on road-sides and encamping-grounds and groups round sarais, schools, dispensaries, thánas, district and police rest-houses, &c., &c.

(*b*). Column 2 should correspond with column 5 of the previous year's return. If the figures in column 5 of the previous year have been found to be erroneous, they should nevertheless be repeated in column 3, leaving errors to be adjusted by entries in columns 3 or 4. When errors have to be adjusted in this way, explanation should be recorded in the column for remarks.

(*c*). The figures in column 5 should be equal to the total of the figures in columns 2 and 3 less by those in column 4.

No. V.

Progress Statement of Avenues for the year

1	2	3	4	5	6	7
District.	Length of roads and canals suitable for avenues.	Length of roads and canals fully stocked with trees at beginning of year.	Length of roads and canals planted during the year.	Length of roads and canals which have failed during the year.	Length of roads and canals fully stocked with trees or plants alive at end of the year.	Remarks.
	Miles and decimals.	Miles and decimals.	Miles and decimals.	Miles and decimals.	Miles and decimals.	

Notes.

(*a*). *Column* 2.—The figures can be conveniently arrived at by scaling with a compass the lengths of roads, canals shown on the district map.

(*b*). *Columns* 3, 4, 5 *and* 6.—The entries will show the lengths of roads and canals planted. In the column for remarks it should be stated to what extent the figures include roads planted with one, two, three, four or five lines of trees.

(*c*). *Column* 3 should correspond with column 6 of the previous year's return. If the figures in column 6 of the previous year have been found to be erroneous, they should nevertheless be repeated in column 3, leaving the errors to be adjusted by entries in columns 4 or 5. When errors have to be adjusted in this way, explanation should be recorded in the column for remarks.

(*d*). The figures in this column should be equal to the total of the figures in columns 3 and 4 less by those in column 5.

No. VI.

Income from Arboriculture during the year

District.	Ornamental Gardens.	Nurseries.	Plantations.	Groves and Avenues.	Miscellaneous.	Total.	Remarks.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	

No. VII.

Expenditure on Arboriculture during the year

1	2	3	4	5	6	7	8	9	10	11	12
	Works.								Establishment.		
	Ornamental Gardens.		*Nurseries.*		*Plantation and Afforestation.*		*Groves and Avenues.*				
District.	Maintenance and repairs of existing gardens.	Extension of gardens.	Maintenance and repairs of existing nurseries.	Extension of nurseries.	Maintenance and repairs of existing plantations and afforestation.	Extension of plantations and afforestation.	Maintenance and repairs of existing groves and avenues.	Extension of groves and avenues.	General supervising establishment, including office establishment.	Total.	Remarks.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	

Note.—It will be seen from Section 14 of Part II (A) that only supervising establishment should be shown under column 10. Executive establishment charges, including the pay of *bhistis*, *mális* and others employed in watering or protecting trees, should be shown under the head "Works."

Punjab Government Press, Lahore—1-5-90—600.

ARBORICULTURE MANUAL.

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☞ The names in the Index are printed as nearly as possible in the same type as in the Manual.

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